VOLUME 37
NUMBER 11

NOVEMBER, 1950

plating

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POLISHING AND BUFFING

See Contents Page 1137

Are you Chemically Finishing ALUMINUM

If so, send for this Booklet which gives valuable information on Satin finishing, removal of Tool marks, Scratches, Brazing flux, and the preparation of Aluminum.

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Heliarc Welding
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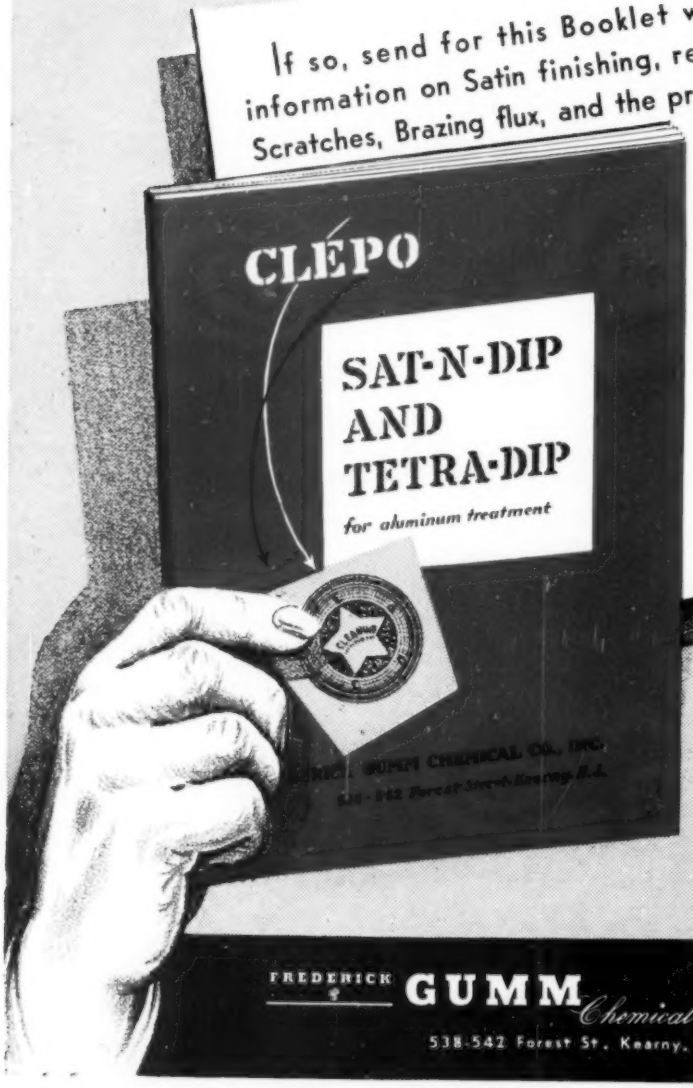

FREDERICK GUMM Chemical Company Inc.
538-542 Forest St., Kearny, N. J.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1090.

stop plating rejects caused by incomplete cleaning

my face was covered . . .

with heavy drawing compound and solid dirt. Alkali cleaning proved ineffective. Rejects ran high. Costs doubled.

10 seconds' soak . . .

in Emulsion Cleaner 75 followed by 15 seconds in alkali cleaner eliminates rejects due to faulty cleaning.

Enthone Emulsion Cleaner-75

1 removes stubborn oil, grease and grime almost instantly

2 insures smoother, brighter, more adherent electrodeposits

3 tapped holes, slots, embossments, corners, crevices, sculptured patterns, emerge completely clean

4 ideal for cleaning work before any phosphate treatment to avoid coarse coatings

Write for literature and operating instructions

Enthone inc 442 Elm Street, New Haven, Conn.

Plating anodes should—must—go into solution uniformly, if an economical, high quality deposit is to be obtained.

That ANACONDA Anodes do so is graphically demonstrated by this photograph. It shows ANACONDA Copper Anodes new and after 24, 36, 48 and 50 hours. Note the smooth surfaces.

Furthermore, ANACONDA Anodes reduce slime to a minimum and scrap losses are exceptionally low.

ANACONDA Anodes are supplied in copper, brass and bronze—rolled sheet or oval; in standard sizes or to your specifications; with or without hooks. Also copper "cathode-anodes." Publication C-5 will tell you more. Write for it to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

For plating with Copper, Brass or Bronze

USE ANACONDA® ANODES

1101 FOR FURTHER INFORMATION, USE READER SERVICE CARD: INDICATE A 1092.

Industry News

New Trichlorethylene Plant. Completion of a large, modern trichlorethylene manufacturing plant at Ashtabula, Ohio, has just been announced by Hooker-Detrex, Inc.

The full production capacity of the new plant will be utilized in the manufacture of Perm-A-Clor and Triad metal-degreasing solvents for the Detrex Corporation, Detroit 32, Mich. It is expected that full production capacity will be reached by November 1, thus assuring all contract customers of their requirements.

Yugoslavia Offers Strategic Metals at Chicago International Trade Fair. Four booths for display of metals were included in the first post-war showing of Yugoslav products in the United States, on August 7–20.

Striking increases in American purchases of Yugoslav metal brought the metal imports in 1949 to $11,672,000, against $2,830,000 during 1948.

"Out of the 26 so-called strategic raw materials, Yugoslavia has 24", Peter M. Nikezic, Commercial Counselor of the Yugoslav Embassy, declared. "In the post-war period, we have concentrated on the development of raw and refined metals to replace basic foodstuffs as our major export.

"Mines have undergone extensive mechanization, stepping up output through new production methods, extension of old mines, and the opening of new ones. Lead exports rose from 5,200 tons a year

SALESMAN WANTED

for Canada by an American concern to sell Buffing and Polishing Compounds and accessories. Should be capable of making $8000 to $10,000 yearly. Feel free to write—our organization is fully acquainted with this advertisement. Please reply to:

P-1150-A
P. O. Box. 168, Jenkintown, Pa.

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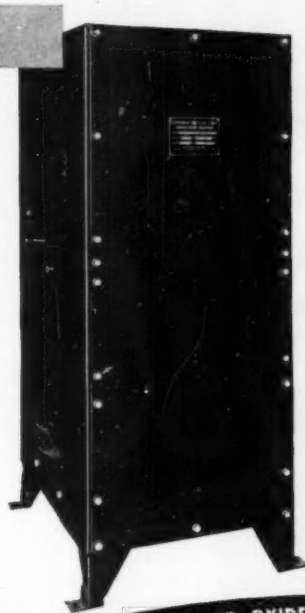
2 Types to choose from

PLATING RECTIFIERS



AIR-COOLED COPPER OXIDE

Greater efficiency at plating currents and less change in characteristics with aging has made copper-oxide one of the most popular of all plating rectifiers. These two features—which mean lower power costs over more years of service—continue to make copper-oxide the top choice for heavy-duty operations, particularly in automatic plating installations.

G-E copper-oxide rectifiers are available with either automatic or manual control. For the ultimate in uniform plating, predictable plating costs and minimum labor, G.E.'s automatic system is your choice. For dependable plating current—with simple, convenient, "at-the-load" current control which is moderate in initial cost—use G-E manually controlled copper-oxide rectifiers.

For complete details, write for Bulletin GEA-5247.

OIL-IMMERSED SELENIUM

General Electric's new oil-immersed selenium rectifiers have been especially designed to operate in corrosive or dusty, linty atmospheres. Rectifier stacks are hermetically sealed in welded, oil-filled cans—can be installed right next to your tank and still give long dependable service. This new selenium rectifier is ideal for barrel plating, too. The high thermal capacity of its oil, plus improved ventilation, enable this rectifier to withstand brief current fluctuations with safety.

Lower initial cost is the third important feature of oil-immersed selenium—and will often outweigh the somewhat higher efficiency of copper-oxide when power costs are not a controlling factor.

For complete details, write for Bulletin GEA-5519.

For application information, call your General Electric Apparatus Department Sales Representative or authorized G-E Agent. ***Apparatus Department, General Electric Co., Schenectady 5, N. Y.***

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the all round ball

Industry News

before the war to 53,000 tons in 1949, and exports of copper, mercury and antimony are also expanding", Mr. Nikezic reported.

Yugoslav production of mercury and bauxite, the raw material from which aluminum is now produced, ranks second in the world, and the country is fourth in antimony, sixth in lead and ninth in copper production. Chrome ore, pyrite concentrates, zinc, and bismuth are the other metals in generous supply.

Accidents. Accident frequency and severity rates in small plants are roughly double those in large plants, and the smaller the plant the higher the accident rates, G. E. Johnson, Assistant Chief of the Division of Industrial Safety of the State of California, recently pointed out.

The small plant owner may be unable to afford a safety engineer charged with nothing but accident prevention, but he cannot afford to be without a safety program, according to Mr. Johnson, and the owner himself must direct and guide the program. He underscored the importance of safety by pointing out that in the small plant one bad accident can wipe out several years' profits. He stressed also that "Little good is accomplished by safety propaganda in irregular and infrequent doses . . . safety mindedness is achieved only by the constant attention to safety in every phase of the day's work".

Symposium on Industrial-Waste-Disposal Control. The Philadelphia section, Instrument Society of America, will present a symposium on "Industrial Waste Disposal—A Problem for Instrumentation" at an all-day meeting to be held in Hotel Bellevue-Stratford, Philadel-

WANTED

Plant for plating Furniture Parts. Write:

BOX P-1150-B, PLATING
P. O. Box 168, Jenkintown, Pa.

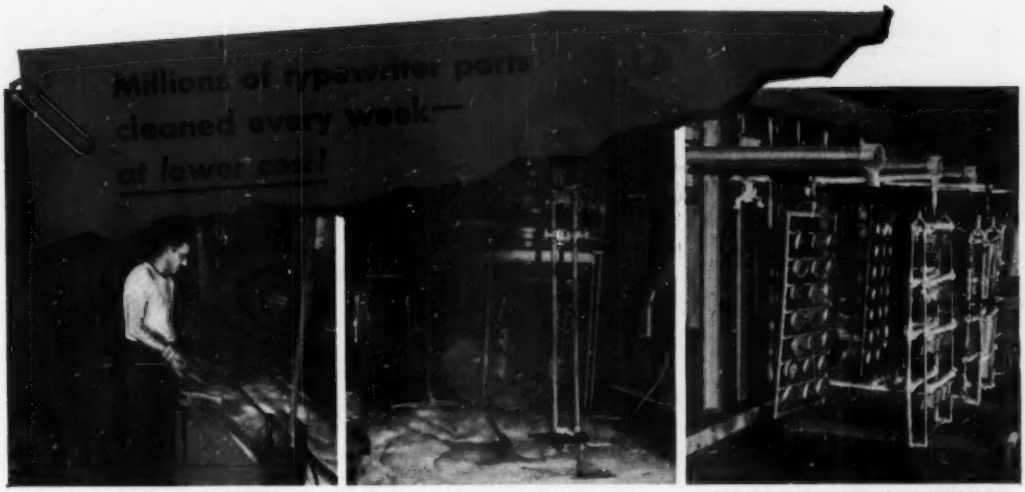
SALES-SERVICE OPENINGS

A large, well known manufacturer of industrial detergents has sales-service openings for *Top Caliber Men* in ten localities throughout the United States and Canada.

Men with college training in chemistry or engineering or metallurgy preferred. Should have experience in metal finishing, plating, vitreous enameling, painting, etc. Reply to:

P 1150-C, PLATING
P. O. Box 168, Jenkintown, Pa.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1095.



Hand-line cleaning of small parts prior to plating at Remington Rand. Reverse electroclean operation uses Pennsalt 45-X at 8 oz./gal., 200°F., 5 to 10 minutes.

Remington Rand Automatic Black Nickel line. Reverse electroclean with Pennsalt 45-X at 8 oz./gal., 200°F., 3 minutes. Followed by rinse and reverse electro lean with Pennsalt K-2 at 8 oz./gal., 2 minutes.

One of two Automatic Semi-Bright Nickel Liner. After two electrocleanings—in baths of Pennsalt 45-X and Pennsalt K-2—the parts enter the plating tanks chemically clean.

How *Remington Rand* gets round-the-clock high production with PENNSALT CLEANERS

More than a million pieces a day—from tiny washers and screws to essential type bars and braces—go through Remington Rand's cleaning and plating lines at their Elmira, N. Y., plant. No doubt about it, this is a high capacity line—operating 24 hours a day. So the cleaner *has* to be good. A breakdown in cleaning could stall production in the entire plant!

For over five years, Pennsalt Cleaners have been used by Remington Rand—were chosen after tests proved they would give this dependable performance at lower cost than former methods. Here's the *two-way economy* these cleaners give Remington Rand:

1. Pennsalt Cleaners are concentrated—contain virtually 100% active ingredients; a minimum of cleaning compound is needed.

2. Pennsalt Cleaners have long life—frequent dumping of large process tanks is unnecessary. At Remington Rand, for instance, tanks are dumped just once a week (running 24 hours a day, this is equivalent to *three weeks* in the average one-shift plant).

As a bonus benefit of using Pennsalt Cleaners, Remington Rand reports that the local Pennsalt Technical Service man has been "very helpful—always available for consultation."

If you have special metal cleaning problems—or if you'd like to know how you may cut costs on your present cleaning operations—it will pay you to consult your Pennsalt Technical Service man. Contact him direct, or write: Special Chemicals Department, Pennsylvania Salt Manufacturing Company, Philadelphia 7, Pa.

The finished product—ready for your secretary!

There's a Pennsalt Cleaner for every metal cleaning operation

PENN SALT

PROGRESSIVE CHEMISTRY FOR A CENTURY

Industry News

phia on November 2. Scheduled speakers include Louis Gess of Minneapolis-Honeywell Regulator Company; William Hart of Atlantic Refining Company; L. Drew Betz of W. H. and L. D. Betz; Bruce Dickerson of Hercules Powder Company; Arthur Gorman of The Atomic Energy Commission; and Francis S. Friel of Albright & Friel, consulting engineers. There will be a dinner, an evening speaker, and motion pictures on waste disposal.

The Superior Electric Company of Bristol, Conn., has opened an office in Cleveland to serve the Ohio and Western Pennsylvania areas. This office, located

Lorenson

in Room 1118, Fidelity Building, 1940 E. 6th St., will be headed by Harold W. Lorenson, who for the past year has been covering the territory from the home office. The Cleveland office will handle the complete line of Powerstat variable transformers for rectifier-voltage control and Stabiline automatic voltage regulators which provide constant a-c voltage.

Enlarged Caustic Soda Facilities. The Pennsylvania Salt Manufacturing Company of Washington is now completing a program of improvements of existing facilities in its plant in Portland, Ore., including enlargement of caustic soda evaporation to permit better work schedules.

Niagara Alkali Celebrates Fiftieth Anniversary. Organized in 1900 under the name of the Roberts Chemical Company, Niagara Alkali Company has pioneered steadily in its field of electrochemistry. It was first to manufacture synthetic caustic potash here. The flaking of alkalies was introduced with the flaking of caustic potash just prior to World War I as a means of meeting German competition for this product, which then sold only in fused, broken, and liquid forms. It was also the first to produce potassium carbonate.

Most recent addition to the company's list of chemicals, while not new, is trichlorethylene of high stability, largely used in metal cleaning and degreasing.

Principal officers of Niagara Alkali are J. Clarke Cassidy, President; S. Willard Jacobs, Vice President; Stephen J. White, Vice President and Treasurer; and William J. Weed, Manager of Sales.

Ferro Enamel Corporation, Cleveland, Ohio announces the appointment of **C. L. Warner,** Haller Oven Company, Pittsburgh, as Sales Representative in the Eastern Pennsylvania territory for the company's industrial ovens, dryers, metal cleaning equipment and complete synthetic-finishing departments.

Plant Maintenance Conference. An 18-point program of plant maintenance techniques has been scheduled for discussion at the Plant Maintenance Conference to be held during the first three days of the Plant Maintenance Show, January 15–18, in the Public Auditorium in Cleveland.

The thirteen U. K. metal finishing specialists visiting U. S. under E.C.A. sponsorship (see last issue) visits Hanson-Van Winkle-Munning Company in Matawan, N. J., for study of its laboratories and plants. In this photo, taken in front of new laboratory and administrative buildings, are, from left to right: Maurice Frey, Bernard Turner, Leslie Connell, Arthur Lines, Fred Willetts, Walter Ehrlinger (Export Mgr., H-VW-M), John Adcock (group leader), D. G. Foulke (Chief Chemist, H-VW-M), George Woodall, Ernest Marsh, Louis M. Hague (President, H-VW-M), Victor Long, Myron Diggin (Technical Director, H-VW-M), Roy Hammond (group secretary), Norman Watts, Frederick Champion, John Neubauer (President, local AFL union), George Hogaboom (Consultant), John Boots (Personnel Director H-VW-M), Norman Tope, Julius Demeter (ECA Project Manager). The group was particularly impressed by the amount of free service given by American industry to its customers in the way of both laboratory and field service; also, the extent to which the plating industry goes in utilizing instrumentation and control equipment to insure the uniformity of deposits

Four general sessions will be held for all visitors and eight sectional conferences for executives and engineers with specialized problems.

General conference sessions will deal with preventive maintenance (inspection procedures and frequencies, records and reports, and training of personnel for maintenance work); organization and management for maintenance (maintenance costs and their control and budgeting, incentive payment of maintenance workers and planning and scheduling maintenance operations); lubrication; and plant housekeeping (painting and decorating, selection and upkeep of floors, and proper standards of sanitation).

Information may be obtained from Clapp and Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

The Foxboro Company, Foxboro, Mass., recently opened two new branch offices, its 38th and 39th, for sale of industrial instruments for measurement and control. The first is at 225 S. 5th St., Minneapolis 2, Minn., with Robert C. Cahill as Resident Engineer; the second at 214 W. 10th St., Wilmington, 1 Del., under the managership of K. L. Barton.

PLATING ENGINEER

Free to travel for research and development department of an important government laboratory. Starting salary, $5400, good opportunity for advancement.

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FOREMAN

Experienced to take complete charge of electrolytic zinc plating line in McKeesport, Pennsylvania. State qualifications, age, salary Expected. Reply to:

P-1150-E, PLATING
P. O. Box 168, Jenkintown, Pa.

CHEMICAL ENGINEER

Chemical engineer with some electro-plating experience for work on new electrolytic zinc plating line in McKeesport, Pennsylvania. State full qualifications, age, salary desired. Reply to:

P-1150-F, PLATING
P. O. Box 168, Jenkintown, Pa.

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Any plant using these three MICCRO products – MICCROTAPE, MICCROTUBE and MICCROTEX – is equipped to coat any and all types of plating racks. All three products possess the same basic dielectric strength and insulating qualities. They may be used separately or together – since they will fuse and blend to form a homogeneous leakproof coating. They may also be used to give increased life to RUBBER COATED RACKS. Throughout the plating industry these three MICCRO products have established highest records of performance and economy.

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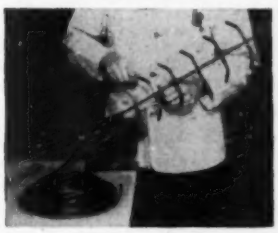
An extruded tape ¾ inch in width, .012" thick in center with tapered edge of .005" (an exclusive feature). Permits much smoother overlapping, closer fit in grooves and around shoulders. Quickly applied – no heat sealing necessary. Has high dielectric strength, remains tough and permanently elastic. Miccrotape may also be used to repair rubber coated racks.

2 MICCROTUBE

An extruded tubing with the same physical and insulating characteristics as Miccrotape. Speedily applied to straight and bent contact wires, also round splines. Will fuse with Miccrotape into a perfect leakproof coating. Available in inside diameters from $\frac{1}{16}$" to 1", in thin-wall or thick-wall tubing.



3 MICCROTEX

Write for detailed bulletins of these three Miccro products.

A superior thermoplastic air-dry insulating material that meets the requirements of all plating cycles and phosphate coatings. May be dipped, brushed or sprayed. Is tough, resilient and flexible – minimizes drag-out – attains maximum adhesion without shrinkage.

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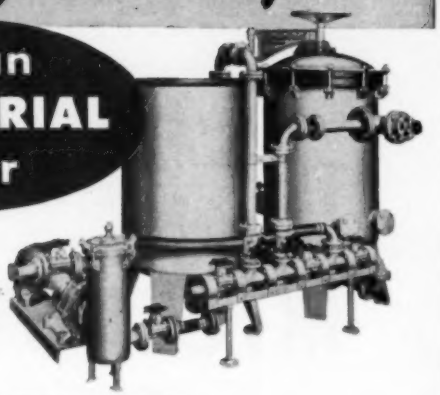
For Any Plating Solution
Any Quantity

use an INDUSTRIAL Filter



100 to 15,000 gallons per hour. Portable and stationary models. Standard or special filtration systems engineered to meet unusual requirements.

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Here's how Industrial filters keep down the cost of plating jobs—The flow rates of Industrial filters are based on the actual plating solutions involved. You know the capacity you get. In the filtration of plating solutions there is more than just the filter. With Industrial you get an adequate filter with slurry tank, motor driven pump, valves and fittings in a complete package with one, undivided, experienced responsibility—with space requirements at a minimum.

The labor, down time, and the inconveniences of cleaning, replacing the filter media, and reassembling the filter for every new filter cycle—all are eliminated by the Industrial Air-Wash Cleaning Method available for all models. It is necessary to remove the cover only when new filter cloths are installed. With Industrial filters, a clarified plating solution is always assured.

The engineering, design, and construction of Industrial filters have proved out in long service and low maintenance costs. Industrial has the experience and is large enough to handle your filter requirements. Since 1927 filters and filtration systems have been an important part of our business.

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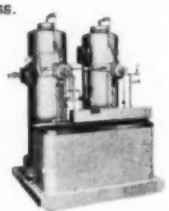

A Two-Bed INDUSTRIAL Water Demineralizer. Standard two-and four-bed units available with capacities of 200 to 1000 gph. Special units of any capacity engineered to requirements.

for **No stains after hot rinse. No unwanted precipitates in solutions.**

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Personals

I. T. Darlington now represents Maas & Waldstein Company as sales engineer in the Eastern Pennsylvania area, including Philadelphia, Baltimore, Md., and Harrisburg, Pa. He has almost thirty years' experience in research, development and servicing of lacquers and synthetic enamels.

Donald L. Patrick, who recently received the Superior Accomplishment Reward for his work with the Naval Ordnance Plant, Indianapolis, Ind., will head Division

Patrick

No. 4 of the Indianapolis Civil Defense Program as Deputy Director. Following attendance at the Naval officers indoctrination course in toxic warfare and radiological defense last year, from which he graduated in the top 10 per cent of his class, and intensive self-study, he taught the subjects at the Plant and to civilians.

Gordon A. Jacobs is now in charge of the Dallas Division, which includes the States of Texas, Louisiana, Oklahoma and Arkansas, of Detrex Corporation. He is a

Jacobs

graduate engineer and has had broad experience in marketing, field servicing, and consulting on Detrex processes for solvent-vapor degreasing, alkali and emulsion cleaning, and rust-proofing.

P. L. Edwards has been appointed Manager of the Central District Office in Pittsburgh of Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J. He succeeds R. C. Rice, who retires from active service. Mr. Edwards has long experience in the sale of industrial rubber products. During recent years he served as assistant to Mr. Rice.

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THE "company" we keep consists of the well-known manufacturers listed below, whose nationally famous equipment we distribute and service. This solid backing, together with our own experienced Planning and Engineering Service. enables us to supply you with COMPLETE PLATING AND POLISHING INSTALLATIONS that, in mechanical excellence, have no superior.

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BARNSTEAD STILL AND STERILIZER CO. Demineralizers, Stills
MEAKER CO. Semi and Fully Automatic Plating Equipment
CENTRAL MACHINE WORKS. Special Finishing Machines
BULLARD CO. Automatic Station Type Conveyors
RICHARDSON-ALLEN CORP. Selenium Rectifiers
ALSOP ENGINEERING CORP. Filters and Mixers
AUTOMOTIVE RUBBER CO. Rubber covered equipment
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ACME WELDING CO. Tanks of all kinds

Also:
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Personals

Dr. G. W. Vinal, retired Chief of the National Bureau of Standards' Division of Electrochemistry and Dean of the NBS staff, was the eleventh recipient of The Electrochemical Society Edwin Goodrich Acheson Medal and Prize. The award, a gold medal and $1,000 prize, is conferred biennially for the most outstanding contribution in the fields of activity fostered by the Society. It was presented to Dr. Vinal at a banquet in his honor on October 12, at the Fall Convention of the Society in Hotel Statler, Buffalo, N. Y.

Dr. Vinal's distinguished career includes 42 years of service on the staff of the National Bureau of Standards, in the Electrical Division. In addition, he has been Chief of the Division of Electrochemistry since its establishment in 1918. He retired from active service at the Bureau in July, 1950. He has been active in the establishment of the values for the international volt and ampere and has had world-wide recognition as an authority on standard cells and batteries.

Dr. E. E. McSweeney of Battelle Memorial Institute, Columbus, Ohio, will henceforth direct relations between the Institute and industry sponsors and assist prospective sponsors of research in setting up their research programs. A member of the Battelle staff since 1938, Dr. McSweeney in recent years has directed plastics, rubber, and coatings research. He is a graduate of Oberlin College and received his Ph.D. degree from the University of Rochester.

McSweeney

R. Peacock, Manager of Dairy Industry Sales for The Diversey Corporation since 1948, has been named Sales Manager of General Reduction Company, a Diversey subsidiary, which mines, processes, and markets absorbtive clays for a variety of industrial uses.

Peacock

Mr. Peacock joined Diversey in 1939 and advanced rapidly from field service representative to a senior salesman and then to Manager of the Farm Quality Control Department.

Almo D. Squitero is now electrochemist in the laboratory of the Hanson-Van Winkle-Munning Company, Matawan, N. J. A graduate of Michigan State College with the degree of Bachelor of Science in Chemistry, he has a year of graduate work in electrochemistry and wide experience in electroplating, electrotyping, and electroforming.

Squitero

Harry E. Stopek has been appointed to a sales-service position with Kraft Chemical Company, Chicago, and will concentrate on metal fabricating and finishing. Chicago born, he took his degree in chemistry from the University of Chicago in 1945 after a year as an exchange student at the University of South Wales, England. He has previously been connected with General Electric Company and Hotpoint as a material and process engineer. He will headquarter at Kraft's main offices in Chicago.

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FOR ALL METALS OR COMBINATION OF METALS

ONE PRICE
ONE SOLVENT
IS ALL YOU NEED

Blakeslee
SOLVENT VAPOR DEGREASERS
are more economical more efficient—USE LESS SOLVENT

NIAGARA
Metal Parts Washers
for use with cleaning compounds on either batch or production jobs.

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BLACOSOLV contains the finest and toughest stabilizers to prevent solvent breakdown. You need not pay premium prices for special solvents for different metals. Blacosolv can be used over and over, under the most rigorous conditions, without impairing its high qualities.

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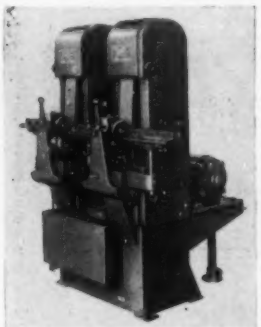
Trade Literature

L— 517. Monel Metal Pickling Chain—Monel metal pickling chain is now being manufactured by the S. G. Taylor Chain Company, Hammond, Ind. This chain has higher strength and resistance to wear than ordinary wrought-iron or carbon-steel pickling chains. Prices, and complete specifications are contained in Bulletin 80. For your copy, use Reader Service Card.

L—518. Centerless Polishing Machine—As a result of a continued demand for a fast machine capable of producing a quality finish on small cylindrical work, the Four-Eighty-Four Duplex Polishing



Machine has been developed by Production Machine Company, Greenfield, Mass. Equipped with two polishing heads, this machine employs whatever type of belts required by the finish. Handling parts up to 1½-inch diameter, the machine will perform a two-pass polishing operation on metal, wood, fibre, plastic, fibreglass, and many other materials within its weight limitations. Only a single handling of material is said to be required, and many parts may be fed to the machine automatically by means of hoppers or fixtures suitable for the individual application. Costs are said to be reduced upward of 50 per cent on comparative work done on a single-head machine. For your copy of descriptive literature giving full particulars and specifications, use Reader Service Card.

L—519. Specifications for Metal Treatment Chemicals—American Chemical Paint Company, Ambler, Pa., offers a specification card which on one side, opposite U. S. Government specification numbers, lists the company's chemicals for phosphatizing, rust-proofing, paint-bonding, rust-removing, metal-cleaning and acid-inhibitor chemicals; on the other side, the chemicals under metal being treated. For you copy, use Readers Service Card.

L—520. Corrosion Resistant Cements—The Atlas Mineral Products Company, 43 Walnut St., Mertztown, Pa., announces the publication of Bulletin No. 5-1 on Corrosion Proof Cements. This bulletin describes Atlas' complete line of resin, sulfur, silicate, and asphaltic cements. Information on each cement is compiled in chart form, which is helpful in the selection of the correct cement for a specific application. Included is information on Alkor 5E, said to be the nearest to a universal corrosion-resistant cement. It is said to be inert to all solvents, alkalies and nonoxidizing acids; have no appreciable shrinkage on setting (in less than 24 hours at 70° F) and no obnoxious odors; have excellent workability; be easily tooled; have adhesion to wire-cut brick greater than 500 psi, tensile strength 1500 psi, compressive strength 15,000 psi. Heat accelerates setting only, produces no fumes or smoke. For your copy use Reader Service Card.

L—521. Burnishing Materials and Barrel Finishing Equipment—Useful information on deep-hardened carbon-steel burnishing materials and barrel finishing equipment is contained in a new, 20-page catalog-manual issued by The Abbott Ball Company, Hartford, Conn.

The new booklet, said to be the first of its kind, in addition to being a catalog of the manufacturers products, is described as a practical reference handbook containing authoritative information on the use of bearing balls, burnishing materials, and finishing barrels. Two of the four sections deal with (1) selection, use, and care of burnishing materials; (2) practical barrel finishing. For your copy, use Reader Service Card.

L—522. Electrical Equipment for Electroplating—The Udylite Corporation has published a new catalog covering its electrical products. The 12-page, 2-color booklet lists the models of Udylite

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Mirror Finish . . .
Easy Cleaning . . . .

SPEEDIE Stainless Steel and Chrome Compositions Fill the Bill Every Time!

ARE YOU getting stainless steel that's rough and tough to buff? Is it hard to remove knicks and scratches . . . and difficult to produce a mirror finish? Then you need SPEEDIE Stainless Steel Compositions.

No. 471 is without a peer for cleaning a dirty piece of stainless steel. It colors as well as *cuts* so you do *two* operations at the same time.

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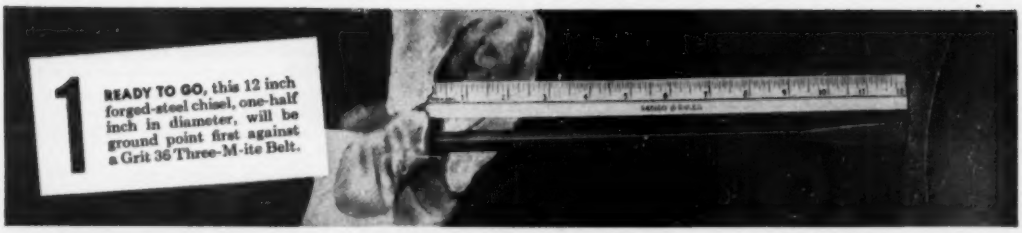
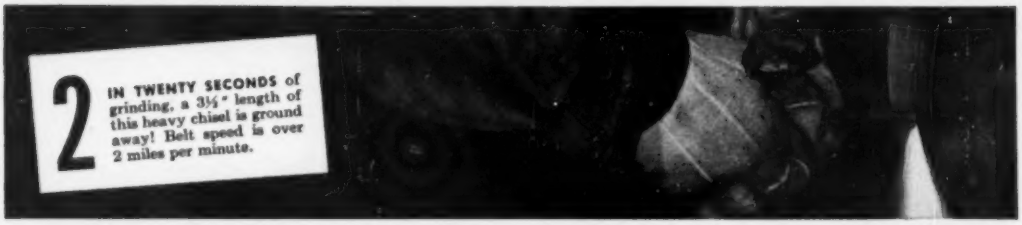
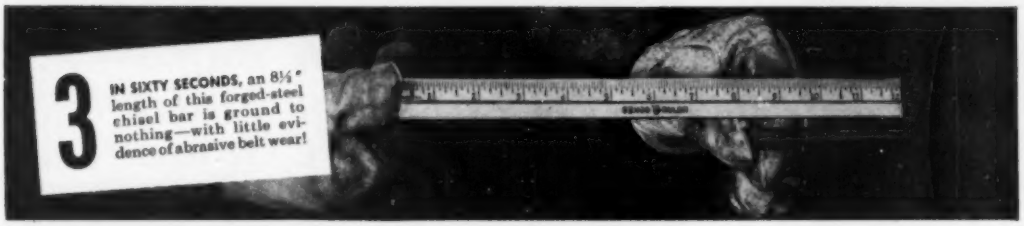

1
READY TO GO, this 12 inch forged-steel chisel, one-half inch in diameter, will be ground point first against a Grit 36 Three-M-ite Belt.




3
IN SIXTY SECONDS, an 8½" length of this forged-steel chisel bar is ground to nothing—with little evidence of abrasive belt wear!

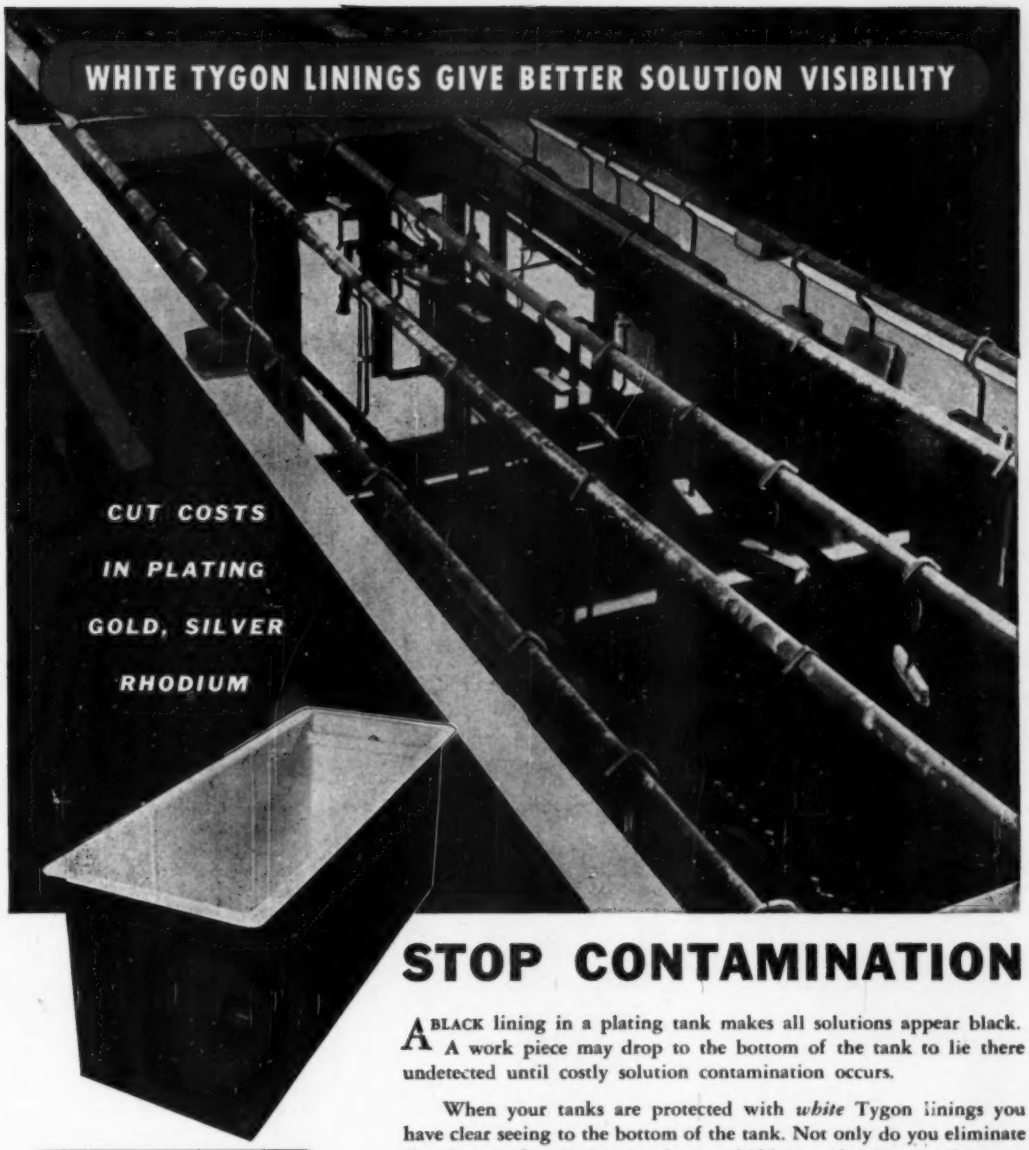
Only 3M Abrasive Belts give you grinding speed like this!

The 3M Abrasive Belt used in this dramatic test was driven at over 2 miles a minute, with complete safety. In just 60 seconds, a ½" diameter forged-steel chisel was ground from 12" long down to 3½"—total of 8½", with little evidence of abrasive belt wear.

What does this remarkable test mean to you? It means the 3M Method and 3M Abrasive Belts can cut your grinding time and abrasive cost. It means real abrasive stamina and quality—the kind you learn to expect when you specify 3M Abrasive Belts.

WE INVITE YOU TO USE OUR DEMONSTRATION ROOMS to work out faster and more economical grinding and finishing methods. A 3M Methods Engineer will show you how modern belt grinding equipment can cut costs. For the address of your nearest 3M Demonstration Room, write Dept. P-115.

Made in U.S.A. by MINNESOTA MINING & MFG. CO., St. Paul 6, Minn., also makers of "Scotch" Brand Pressure-sensitive Tapes, "Scotch" Sound Recording Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-Slip Surfacing, "3M" Adhesives. General Export: Durex Abrasives Corp., New Rochelle, N.Y. • In Canada: Canadian Durex Abrasives Ltd., Brantford, Ontario.



STOP CONTAMINATION

A BLACK lining in a plating tank makes all solutions appear black. A work piece may drop to the bottom of the tank to lie there undetected until costly solution contamination occurs.

When your tanks are protected with *white* Tygon linings you have clear seeing to the bottom of the tank. Not only do you eliminate the chance of corrosive attack on a hidden work piece causing contamination, but you can tell at a glance when to filter.

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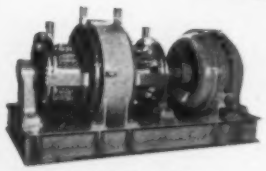

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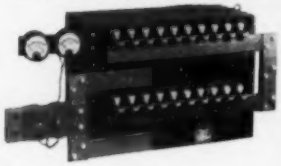

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Trade Literature

rectifiers, regulators, switches, rheostats, and other electrical equipment for use in electroplating operations. Copies may be obtained by writing to The Udylite Corporation, Detroit 11, Mich., on your firm's business letterhead, mentioning PLATING.

L—523. Cyclone-Type Dustcollectors—Hammond Machinery Builders, Inc., 1613 Douglas Ave., Kalamazoo, Mich., announces the addition of two new

models to their line of Cyclone Type Duskolectors. Model CYO-6, as shown, is recommended for exhausting air to the outside. Model CYB-6, now shown, is of the same construction, except that it is fitted with a dust-proof bag and is adaptable where conditions permit recirculation of the air. Both provide a heavy-duty collecting system for dust, grit, lint, sawdust, plastics, buffing compounds, etc.

Capacity of both models is 1150 cfm, velocity 5600 fpm with 2-hp motor. Base is 2 inches in diameter and dust-pan capacity is 10,620 cu. in. Overall height is 86 inches, inlet size 6 inches, outlet size 7 inches. For descriptive bulletin and details, use Reader Service Card.

L—524. "Finishes for Aluminum" Manual—The 1950 edition of the process manual, "Finishes for Aluminum," has just been published by Reynolds Metals Company, 2500 S. 3rd St., Louisville, Ky., and is available without charge to engineers, chemists, production men, and others when requested on company letterhead.

CHROME PLATING TANKS

FOR SALE—Two tanks, 4 years old, good condition. Brick-lined, blower hood and copper included. Both tanks 9 ft. long, 38 in. deep. One 32 in. wide; other 28 in. wide.

THE WESTFIELD MFG. CO.
WESTFIELD, MASS.

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This new Federated ANODES catalog is full of facts that every man in the plating business should know.

Emphasizes usable data on M-Sterling Chill-formed copper anodes, and those of zinc, tin, brass and cadmium. Anodes are listed in full detail as to size of body, length of hooks, position of markings and other essentials. Drawings indicate shapes, dimensions, styles of ribs and cores.

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Trade Literature

It includes information on 10 cleaning treatments, 15 mechanical finishes, 16 chemically produced finishes, 11 electrolytic oxide finishes, organic finishes, and such specialized finishes as luminous paints and vitreous enamels. A section is also included on controls and tests. All finishes are presented so that the reader can tell which are commonly used and which are more or less in the experimental stage. Step-by-step schedules for applying various types of finishes, data on properties and characteristics of the aluminum alloys, action of some chemicals on aluminum alloys and their relative resistance to corrosion are also included, as well as a guide for approximating typical costs of applying 20 different treatments.

The 124-page 6x9-inch wirebound book contains 37 illustrations, 18 tables, a table of contents, and an itemized cross index.

L—525. Metallic Lubricant—The new "oil made of metal" introduced six months ago by the Lubricants Division of The Lockrey Company, College Point, N. Y., is a molybdenum-base lubricant designed to meet especially severe conditions. Technical Bulletin No. 21-E just published describes four types, Liqui-Moly NV Regular and Grease, Liqui-Moly NV Thread Compound, and Moly-Wax-Stix.

These lubricants are specially-treated compounds of the extremely "greasy" metal molybdenum, which has the peculiar property of attaching itself by molecular attraction to metal bearing surfaces, forming a lubricating film that cannot be "squeezed out" by any amount of pressure, and which can withstand unbelievable extremes of temperature without affecting its lubricating qualities. For your copy, use Reader Service Card.

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EQUALLY IMPORTANT FOR MILITARY and civilian needs is their use in producing coatings of excellent solderability on radio or electrical parts where the use of a non-corrosive flux is desirable. The fluoborate electrolyte produces an even, fine-grained coating . . . and is faster . . . more economical than hot dipping. Storage tests have shown that parts plated with lead-tin alloy retained this excellent solderability characteristic, whereas other coatings are adversely affected.

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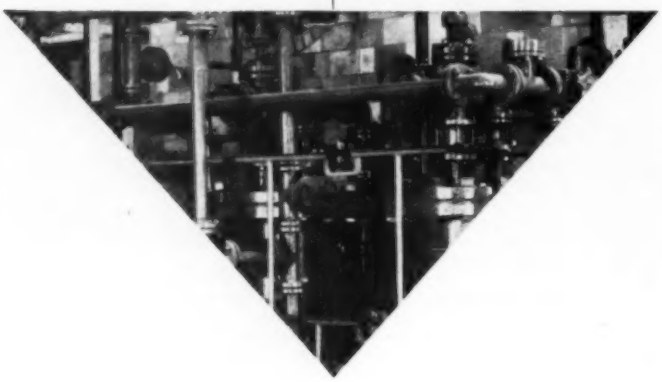
cuts repairs and replacements to a minimum!



The conveyance of corrosive liquids can prove as hard on profits as it is on equipment. It's this realization that has compelled more plants than ever before to install corrosion-resistant saran lined steel pipe. Saran's resistance to most chemicals and solvents reduces shutdowns and lost production! Saves time and labor!

Saran lined steel pipe is available in maximum lengths of 10 feet and in sizes from 1 to 6 inches inclusive. Also available are saran lined diaphragm valves, plug valves, flanges, reducing flanges, flanged fittings, gaskets and fittings with union ends.

Write us today for further information concerning saran lined steel pipe and how it may help solve your corrosion problems. Manufactured by The Dow Chemical Company, Bay City, Michigan, distributed by Saran Lined Pipe Company, Dept. TSP-61.

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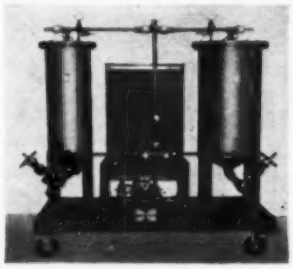
SARAN LINED PIPE a DOW product

Equipment and Supplies

E—578. Filter—A specially-designed filter unit has been announced by Titeflex, [illegible], 500 Frelinghuysen Ave., Newark 5, N. J. Constructed of 316 stainless steel, it includes one filter chamber of 10-sq. ft. filtering area and one of 20-



sq. ft. area. Also included is a precoat tank, and the unit is so constructed that filter chambers can be operated simultaneously with the precoat tank, or singly, as required. Thus a choice of 30, 20 or 10 sq. ft. filtration area may be obtained from the same unit, and peak operating efficiency is maintained at all times whether batch sizes are small or large. As all Titeflex filters, this unit uses permanent filtering elements within the chambers and requires no bags, pads, or sheets. Due to the standard Titeflex backwash system, cleaning of the unit is accomplished in approximately 20 minutes, without manual labor. For further information, use Reader Service Card.

E—579. Solvent Cleaner—Cyclodiene, a liquid-hydrocarbon degreaser fluid for all metals, is offered by Technical Processes Division, Colonial Alloys Company, Philadelphia 29, Pa. Among desirable properties are (1) high speed of dissolving greases, oils, buffing compounds, and other "dirts"; (2) room-temperature application; (3) being nonchlorinated, it does not cause rusting of iron and steel; (4) long life before becoming oil "loaded"; (5) lack of toxicity either as vapor or liquid; (6) safety-solvent rating with a relatively high flash point; (7) leaves a thin protective film on the metal to prevent rusting during handling and in-between shop operations; (8) reasonably short drying time; (9) can be used as a straight degreaser or as a soak prior to vapor degreasing. Method of application is by dip, spray, wipe, or brush; (10) low cost; (11) can be distilled for reuse. For test sample, write to Company on firm stationery and mention PLATING.

E—580. Face Shields—Fendall Com-

A superior, bright protective finish for zinc where the maximum in corrosion resistance and appearance is desired.

PROMAT DIVISION, Poor & Company
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Like "Sterling" on Silver

scientifically compounded

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DOUBLE AND SINGLE ROLL CUTLERY GLAZING MACHINES

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FAST DRYING!
BRUSHING OR SPRAYING!
USED IN ALL TEMPERATURES!
WITH GRAIN SIZES 46 TO 600!*

The grain is covered thereby eliminating harsh cuts. Cutting qualities continue for the life of the wheel, and by actual tests in factories *INCREASED* the *PRODUCTION 400%* on wheel set-up . . . MUCH BETTER FINISHES WERE OBTAINED!

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J. J. SIEFEN CO.

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Equipment and Supplies

pany, 4631 N. Western Ave., Chicago 25, Ill., has recently introduced a new line of face shields available with two types of headgear. One type is equipped with overhead brow guard or spark-deflector; the other has open top for ventilation on hot jobs. The entire headgear is said to be

sturdily constructed with the headbands formed to insure maximum comfort. Windows snap onto headgear and are quickly interchangeable. A wide variety of windows is available: clear, green, or wire screen, in sizes and thicknesses to meet every requirement. For further information, use Reader Service Card.

E—581. Dust Collector—Designed for separating buffing, polishing and other industrial dusts from the air stream and discharging cleaned air and toxic fumes out-of-doors, the Model 90N50 Dustkop dust collector is a standard, pre-tested unit manufactured by Aget-Detroit Company, Ann Arbor, Mich., ready for shipment from stock. It has a capacity of 10,050 cfm developed by a 15-hp motor driving a paddle-wheel fan. A static suction of 4 inches on a 15-inch inlet is observed on instrument test. The size of the air outlet is 18-inch diameter. Motor is available for operation on 220 or 440 volt, 3 phase, 60 cycle power, but motors for operation on other power supply can be supplied. For further information, use Reader Service Card.

E—582. Buffing Kit—A "How-to-Do-It" Buffing Manual, written for the hobbyist and home-workshop enthusiast, is one of the features of the new Dico Buffing Kit offered by the Hardware Products Division of Divine Brothers Company, Utica, N. Y. The kit contains two 6-inch Dico Buffing Wheels, two tubes of buffing composition (rough and tripoli), and two pairs of toothed flanges. Cutlery, hardware, plumbing fixtures, silverware, jewelry, etc., can be buffed and polished at home with this kit, available at retail hardware stores and mill-supply firms.

HD-N

Cuts Cleaning Time

Cowles HD-N Cleaner, the *new* heavy-duty soak cleaner for ferrous metals, will often do in 10 minutes what it takes other cleaners 30 minutes or more to do. It is specifically formulated as a straight or barrel soak for precleaning before plating, enameling, pickling, painting, back-shop reconditioning—or anywhere a heavy-duty cleaner is needed to remove stubborn types of soil.

The latest developments in metal cleaning research have been incorporated in HD-N to assure maximum detergency under all conditions of usage.

HD-N may also be used on such active metals as brass and zinc, if some attack is acceptable.

HD-N penetrates and removes such soils as oil, carbon, grease, drawing compound, graphite, road and shop dirt in *one* cleaning operation. It is fast, thorough, and does a complete job . . . is readily and completely soluble in hot water.

COWLES CHEMICAL COMPANY

Metal Cleaner Department

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Please send me complete information on COWLES HD-N CLEANER.

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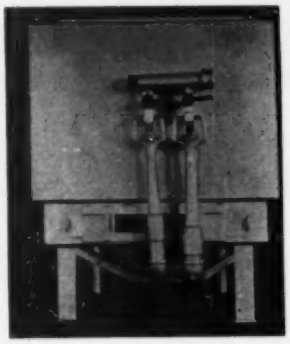
For tanks that serve better, longer, see STORTS



Right—Stortswelded gas fired tank for a black oxidizing salt bath. Insulation is by magnesia blocks. Heat source is a two-ring burner.

NO MATTER whether the tanks you need are plain and simple or more complex and fitted with special purpose accessories, Storts has a wealth of experience in handling all the problems of detail. And Stortsweldmen are skilled in the fabrication and assembly of complete units, ready for action as delivered.

42 STONE STREET — STORTS WELDING COMPANY INCORPORATED — MERIDEN, CONN.

Manufacturers of Welded Fabrications to Specification

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1114.

INSURANCE

You carry insurance on your Business, House, Car and Life. Why not on your plating tanks? They are the life blood of your business. It's cheap insurance to protect your equipment and production from baffling, costly and invisible short circuits by installing TRUE INSULATORS in your steam, water and air lines.

The TRUE Insulator

is manufactured especially for insulating plating tank coils; is of rugged construction, and easily installed.

Provides two inches of absolute insulation.

Fitted at each end with male couplings which grip the Rayon Braided Steam Hose permanently; and become an integral part of your steam, water and air lines.

Are available in the following sizes:

½ inch..... $6.50 per pair
¾ inch..... 6.50 per pair
1 inch..... 7.50 per pair

Discounts allowed for quantity purchases; special sizes considered for special uses.

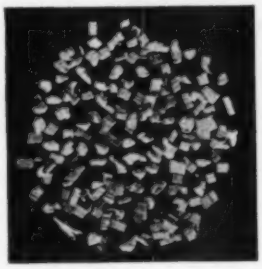
TRUE BRITE CHEMICAL PRODUCTS

P. O. Box 31, Oakville, Conn.

PRACTICAL PRODUCTS FOR PRACTICAL PEOPLE

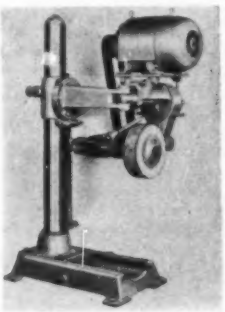
Equipment and Supplies

E—583. Barrel Polishing Medium—Kube-Kut, Inc., 625 Midland Ave., Garfield, N. J., announces a new barrel-polishing and -drying medium, "Korn-Kube" (patent pending), for all metals,



plastics, rubber, wood, glass, and other materials. The new medium is composed of hardwood (maple), cut into cube form and diced, and macerated corn cobs, both of which have been thoroughly screened and aspirated to remove dust. The mixture is said to combine the high absorption of sawdust with the tougher polishing action of the pulverized corn cobs. A variety of mixtures and particle sizes are available to meet specific conditions. For further information, use Reader Service Card.

E—584. Polishing Heads with Three-Year Spindle Guarantee—A new universal polishing or buffing head has been designed by Murray-Way Corporation,



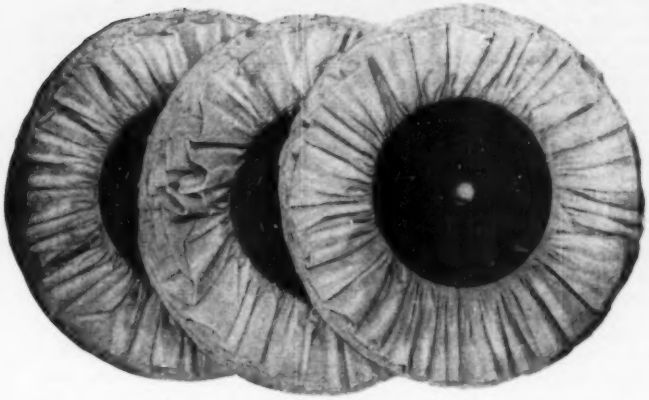
Detroit, Mich., to meet the need for a compact, low-cost head to economize on floor space but provide extreme versatility in positioning and action.

Known as the 60 series, the heads will be made available in two standard sizes: No. 61 rated at 10-15 hp and the No. 62 rated at 5-7½ hp. Both will have substantially the same design and features.

The new heads will operate either right or left hand, without extra brackets or extensive mechanical adjustment, by simple changeover. They will operate on 3-foot centers, thus greatly reducing the

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1115.

RELIANCE PRODUCTS



NUWAY BUFFS

MANY FOLDS TO HOLD COMPOSITION USED FOR FAST CUTTING, FLAT AND ROUND SURFACE WORK.

EXTRUDED COMPOSITIONS

MORE COMPACT, NO LOSS FROM BREAKAGE, MORE ECONOMICAL.

RELIANCE MIDGET PLATING BARREL

TUB CAN BE LIFTED OUT FOR DUMPING AND TUMBLING BARREL INSERTED FOR TUMBLING INSTEAD OF PLATING—VERY RIGID—THREE SPEEDS.

Chas. F. L'Hommedieu & Sons Co.

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and
Los Angeles

FOR FURTHER INFORMATION, USE READER SERVICE CARD: INDICATE A 1116.

Equipment and Supplies

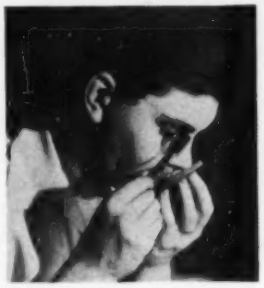
required diameter of dial-tables and permitting substantial economies in the length of conveyors and the number of fixtures required. Special pneumatic controls are said to assure constant, accurate work-pressure automatically. For further information, use Reader Service Card.

E—585. Shadow-free Switchboard Instruments—A new cover design which permits shadow-free illumination of instrument scales with conventional room lighting is the feature of a new line of 4¼-inch long-scale switchboard instruments announced by General Electric's Meter and Instrument Divisions.

Designed as Types AB-18 (a-c) and DB-18 (d-c), the instruments employ a protruding convex-type glass cover that permits the scale to be mounted flush with the front of the instrument case. Shock-resistant bearings in the new instruments protect jewels and pivots under all normal, and many adverse, conditions. Magnetic damping assures quick response and permanency of characteristics. Models include d-c ammeters and voltmeters and a-c ammeters, voltmeters, wattmeters, frequency meters, power-factor meters, and synchroscopes.

E—586. Drum Filling Funnel—Industrial Products Company, 2824 N. 4th St., Philadelphia 33, Pa., announces a newly designed 5-gal. funnel for refilling drums when in horizontal position. Strong steel legs clamp tightly to the drum chime to prevent tipping, spilling, or slopping. Both hands are free for pouring. Manufactured of heavy gauge galvanized iron, reinforced with steel rivets, the funnel is designed for hard usage. For further information, use Reader Service Card.

E—587. Magnifier—A new 10-power Hastings Triplet Magnifier (Model S-171) has been added to the line of Industrial Inspection Instruments manufactured by



the Buhl Optical Company, Dept. TP-7, 1009 Beach Ave., Pittsburgh 12, Pa. The optical system consists of three elements cemented together. Chromatic and spherical aberrations are fully corrected, assuring a sharp, flat image to the edge of the ¾-inch field of view. Focal length is 1-inch. For further information, use Reader Service Card.

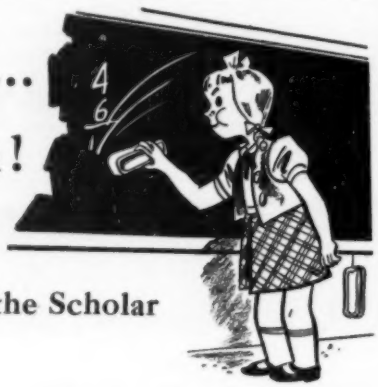
E—588. Equipment from Cold-Cast Pennsalt Resins—A new line of chemical process equipment, made of synthetic resins and designed to meet stringent corrosion-resistance requirements, is now being manufactured by the General Ceramics and Steatite Corporation, Keasby, N. J.

The new equipment, trade named Kemplas, is made of modified phenolic resins developed and produced by the Pennsylvania Salt Manufacturing Company. The resins are either cold cast or laminated for higher strength with glass cloth and molded into desired shapes.

Maximum operating temperature is 350° F. The materials are resistant to virtually all acids except highly oxidizing acids. With certain modifications to the resin, equipment can be made that will withstand definite concentrations of alkalies within certain temperature limitations.

Currently the General Ceramics and Steatite Corporation is offering a wide range of castings, including Hills-McCanna valves, complete pumps, pipe fittings, and cast vessels up to 30 inches in diameter. Laminated equipment will shortly be available in rectangular and cylindrical vessels and pipe up to 6 inches in diameter and 4 feet in length. Some applications in which the material has been tested are in electrolytic cell covers, fans, agitators, towers, headers, ejectors, nozzles, weighing and sample bottles, lined steel pipe, and lined process vessels.
For further information use Reader Service Card.

Start Clean... Stay Clean!



A Good Rule for the Scholar and the Plater

A lot of expensive time and labor goes into preparing metal for plating. *You can waste it all by putting the work into a plating bath of questionable purity!*

Start clean . . . *stay* clean! Red Label Darco S-51 adsorbs to *its* surface the impurities that cause trouble in plating baths before they can be deposited on the freshly cleaned surface of your work.

Red Label Darco is especially treated for use in plating—*the only carbon that meets the benzol-mercury test!* It is especially easy to handle . . . to wet . . . to incorporate into a slurry. Place an order for Red Label Darco S-51 today. Practically all leading suppliers carry Darco in stock. *Do not accept substitutes!*

Is your plating bath as clean as the water in your final rinse?

DARCO DEPARTMENT
ATLAS POWDER COMPANY
Darco General Sales Offices
60 East 42nd Street, New York 17, N. Y.

What is RINS-AID?

RINS-AID is a new product that has unusual properties in giving a water-repellent film to freshly plated work when dipped in a static rinse tank containing only 10 ounces of RINS-AID per 100 gallons of water.

Why do Plated Parts Need RINS-AID?

Rinsing is an essential step in every plating operation but presents its own problems of drying and staining of practically all metals. RINS-AID solves these two problems simply because the water repellent surface it forms on freshly plated parts makes almost all of the water flow instantly from the surface before staining occurs.

What Else Does RINS-AID Accomplish?

RINS-AID imparts a buffed appearance to chrome, gives a uniform velvety appearance to cadmium, eliminates buffing of stained parts, in many cases eliminates sawdust drying, removes water from the inside of tubes and other inaccessible areas, and makes active electropolished or bright dipped surfaces dry better without staining. The final hot water rinse is kept cleaner and operates cooler, avoiding rapid rusting and scaling of steel tanks.

Is RINS-AID Expensive to Use?

All these advantages are yours at negligible cost because such a very small concentration of RINS-AID is used in a static rinse and is effective for hundreds of square feet of work.

ROHCO

ROHCO PRODUCTS
NO-CRO-MIST • HULL CELL TEST •
ROHCO 20XL CADMIUM BRIGHTENER
ROHCO 100 BARREL AND STILL ZINC
BRIGHTENERS • RINS-AID • CROMETER

R. O. HULL & CO., INC.
1302 Parsons Court
Rocky River 16, Ohio

Canada: Armalite Company, Ltd.
Toronto 6, Canada

"YOUR PLATING IS BEST WITH THE HULLCELL TEST"

SEE FOR YOURSELF • *JUST PIN THIS COUPON TO YOUR LETTERHEAD!!*

R. O. HULL & CO., INC.
1302 Parsons Court
Rocky River 16, Ohio

Gentlemen: Please send at once, on our order—

☐ One Quart of RINS-AID ☐ Send FREE Literature
☐ One Gallon of RINS-AID

Name.....

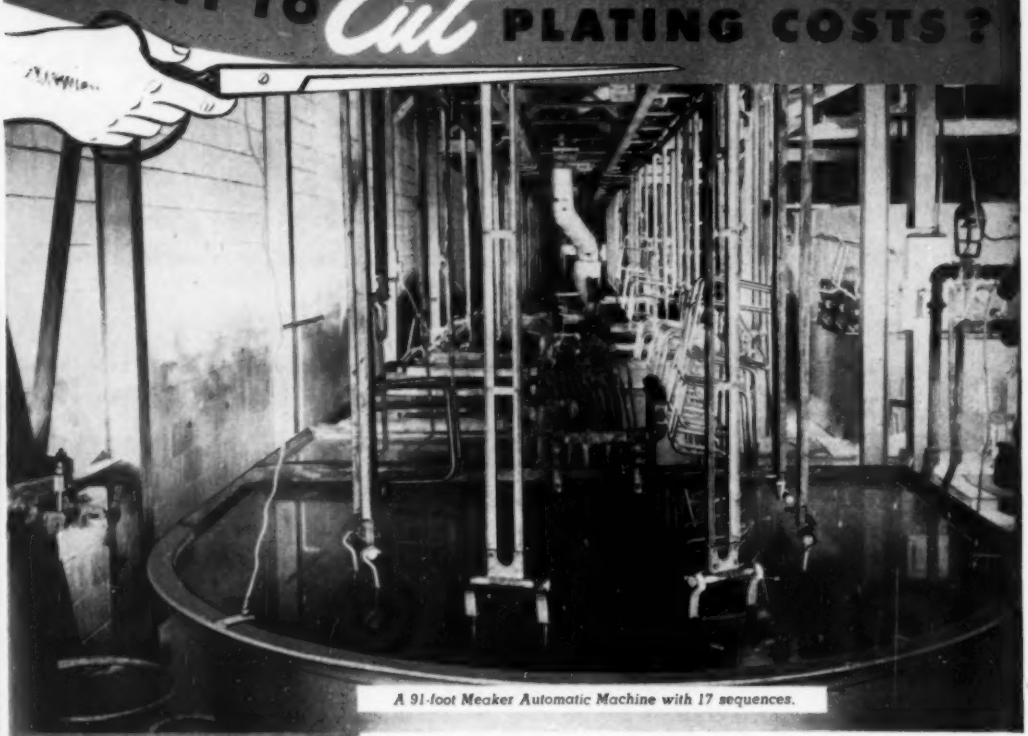
Company.....

Street Address.....

City..... Zone..... State.....

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1118.

WANT TO *Cut* PLATING COSTS?



A 91-foot Meaker Automatic Machine with 17 sequences.

Get Results with a MEAKER PLATING MACHINE

You save three ways with a Meaker plating machine. In many cases the savings in labor costs, space, and chemicals alone have paid for the Meaker equipment in a very short time. Increased production is a natural result. A better and more uniform plating job is assured. Furthermore, cleaner and more agreeable working conditions reduce personnel turnover to a minimum.

A Meaker machine makes every operation in the plating sequence automatic, or as mechanized as possible. It is the profitable way to do electroplating on a competitive basis. Large percentage savings have been the rule both in the plating departments with medium output and in the mass production plants.

Look to the handling methods in your plating work. There may be an opportunity to save a lot of money. Whatever your requirements call for—full automatic, semi-automatic, or a special machine—Meaker has the answer. Get the Meaker booklet. It shows actual installation photographs of machines that have reduced operating costs for others—these machines can do the same for you.

Ask for Booklet No. 148

MEAKER PRODUCTS

Serving the Plating Industry for over 50 Years

THE MEAKER COMPANY

1639 South 55th Avenue, Chicago 50, Illinois, Telephone Bishop 2-1920

E—589. Test Panels—Henry A. Gardner Laboratory, Inc., 4723 Elm St., Bethesda 14, Md., supplies clean test panels of various grades of cold rolled steel and coke tin plate. For further information, use Reader Service Card.

E—590. Protective Masks—General Scientific Equipment Company, 2700 Huntingdon St., Philadelphia 32, Pa., supplies G-S Protective Masks No. 42A,

which consists of an aluminum shield held in position by an adjustable elastic head band and replaceable laminated filters of extra thickness. They protect throat, nose and bronchial tubes from larger particles of nontoxic dusts that irritate and cause discomfort and increased susceptibility to infection. Weighing less than ½-oz., the masks are said to be cool and comfortable. For further information, use Reader Service Card.

E—591. Pretreatment of Aluminum for Painting. Metal Finishing Division, Pyrene Manufacturing Company, 10 Empire St., Newark 5, N. J., now offers a patented process which has been in use by the Company in both Great Britain and America for a number of years.

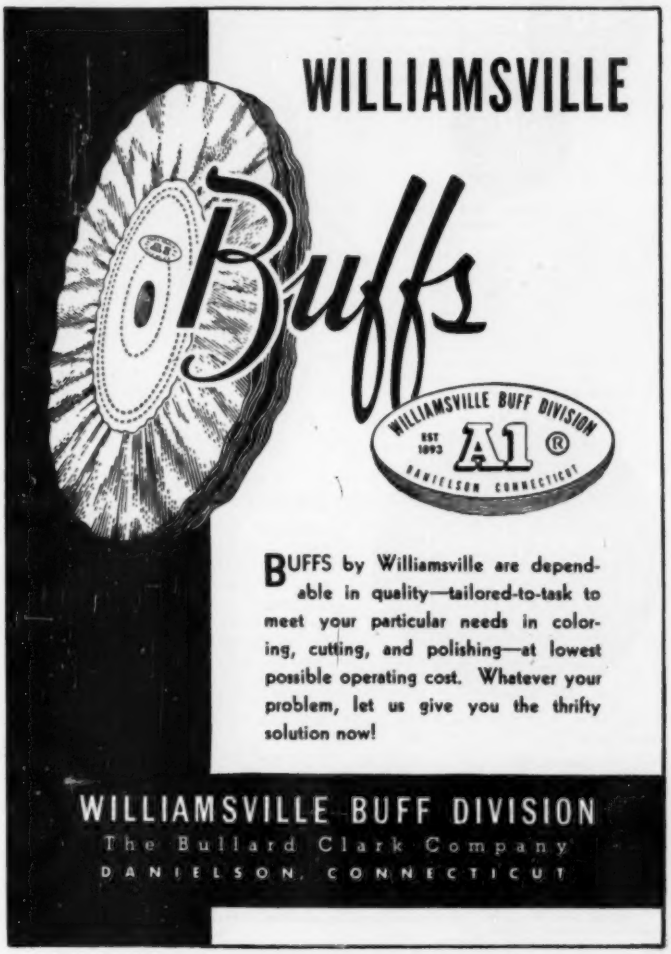
This Pylumin process is said to give an attractive coating of definite corrosion-protective value if no paint finish is applied and in addition to provide an adhesive base for paint finishes. A simple immersion process, it employs a single powder of premixed ingredients. The solution is maintained with a test kit and, when necessary, by the addition of the single powder. Ordinarily heated steel tanks are used. Unless there is an exceptional amount of grease and dirt on the parts, no special cleaning is required, cleaning and processing being done in one operation.

The Pylumin process does not require a license but simply the purchase of Pylumin chemicals and the Pylumin test kit supplied with full instructions for installation and operation. For further information, use Reader Service Card.

E—592. Universally Adjustable Spindle Polishing Stand—The Spindle Stand manufactured by Vonnegut Moulder Corporation, 1819 Madison Avenue, Indianapolis 25, Ind., is designed for finishing and polishing work which is to be pushed across a table by hand or power feed. Motor can be turned to point spindle straight up, straight down, or to any angle between these extremes. It has 20 inches of vertical adjustment and 5 inches of adjustment lengthwise of the spindle. For further information, use Reader Service Card.

E—593. Hot Enamels—Savings in labor and material costs are said to be achieved through the application of synthetic enamels at elevated temperatures, usually around 160° F. Like "hot" lacquers, these new enamels, manufactured by Atlas Powder Company's Finishes Department, Wilmington, Del., can be heated with any of the commercial paint heaters on the market and applied with standard-type spray guns. With the higher percentage of film-forming solids, made possible by the use of heat instead of thinner to reduce viscosity, a heavier film is deposited on the surface and fewer coats are required than with enamels applied at room temperatures. Hot enamels are said to flow easier, giving a smoother surface with higher gloss. For further information, use Reader Service Card.

E—594. Liquid Tripoli Compositions—Acme 2-L-177 and 2-L-178 are the latest additions to the line of moderately priced liquid tripoli compositions made by the Hanson-Van Winkle-Munning Company, Matawan, N. J. The new compositions are oil-water emulsions. Excellent cutting qualities are said to be combined with an unusually high coloring ability for the degree of cut obtained. Acme 2-L-177 is recommended for maximum cut and 2-L-178 for cut-color on such materials as brass, die castings, aluminum, or whatever a general purpose tripoli would be used. For further information use Reader Service Card.


WILLIAMSVILLE
Buffs
WILLIAMSVILLE BUFF DIVISION
EST 1893
A1 ®
DANIELSON CONNECTICUT
BUFFS by Williamsville are dependable in quality—tailored-to-task to meet your particular needs in coloring, cutting, and polishing—at lowest possible operating cost. Whatever your problem, let us give you the thrifty solution now!
WILLIAMSVILLE BUFF DIVISION
The Bullard Clark Company
DANIELSON, CONNECTICUT

FOR FURTHER INFORMATION, USE READER SERVICE CARD: INDICATE # 1120.

Announcing

GRAV-I-FLO PROCESS

and equipment for tumbling

25% FASTER!

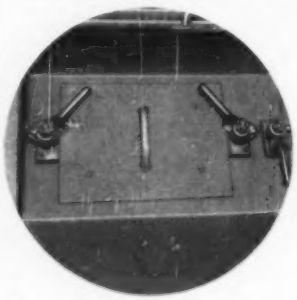
30% MORE VOLUME!

Than Comparable Machines Occupying the Same Square Feet of Floor Space.

30% LARGER WORK LOAD!

MODEL 48-2

5'8" width x 5'4" depth x 5'8" height. Two 24" x 40" I.D. compartments, furnished ½" plate unlined or ¼" plate rubber lined. Cam lock doors have manual release safety stops. Reduced voltage control on magnetic starter. Lever or push-button switch. Limit switch on safety guard. 220-440 volt, 3 phase, 60 cycle motor with magnetic brake. Water attachment with hose. Counterbalanced safety guard. Variable speed drive and timer controls optional. Hoist pan has tubular yoke with manually operated lock. All standard equipment.



Cam locks on doors have manually released safety stops for pressure relief.

Distributors:

Crown Rheostat and Supply Co.
3465 N. Kimball St., Chicago 18, Ill.

W. M. Fotheringham
977 Niagara St., Buffalo 13, New York.

Semmers Brothers Mfg. Co.
3439 No. Broadway, St. Louis 7, Mo.

A. J. Lynch and Co.
2424 Enterprise St., Los Angeles 21, Calif.

R. W. Renton and Co.
877 Addison Road, Cleveland 3, Ohio.

Enthone, Inc.
442 Elm Street, New Haven, Conn.

Fotheringham Platers Supplies, Ltd.
6 Frank St., St. Catharines, Ontario.

GRAV-I-FLO is an entirely new and improved process for tumbling metal parts—grinding, de-burring and finishing—employing newly developed materials and specially designed equipment to produce desired finishes faster and in larger volume. Giving a smoother surface and higher lustre, Grav-i-Flo Super-Brite finishing chips will cut 25% faster on non-ferrous metals, and eliminate the need for subsequent operations such as ball burnishing. Grav-i-Flo compounds change chip surface from finishing to cutting in minutes. Parts need not be transferred from cylinder. Grav-i-Flo natural and synthetic de-burring chips are obtainable for all de-burring needs on various alloys. Added savings are made with Grav-i-Flo Machines which have 30% more capacity than comparable equipment. Check with Grav-i-Flo for all tumbling needs—machinery, accessories, grinding chips, and grinding, finishing and burnishing compounds.

Samples Processed Free! Grav-i-Flo Sample Processing Department will gladly tell you how to attain a better finish at lower costs. Send samples to distributors or direct to Grav-i-Flo Corporation.

THE GRAV-I-FLO CORPORATION
Dept. P-11 400 Norwood Ave. • Sturgis, Michigan

GRAV-I-FLO **TUMBLING**

EXPERIENCE

Makes Seymour Phosphor Bronze Wire a dependable part of your product

The men who guard the high quality of Seymour Phosphor Bronze Wire through each mill operation are veterans in the production of wire to exact specifications.

When this wire becomes a part of *your product*, you have added a dependability that can come only with experienced manufacture of this important alloy.

THE SEYMOUR MANUFACTURING COMPANY, SEYMOUR, CONN.

SEYMOUR

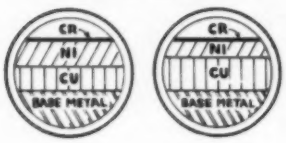
News about UNICHROME Trade Mark COATINGS for METALS

METALLIC ORGANIC DECORATIVE PROTECTIVE

WAYS TO BEAT SHORTAGES IN METAL FINISHES

Avoid problems due to scarcities by taking advantage of other time tested techniques. For example:

Copper Saves Nickel



not this *but this*

If you are short on nickel, why not use more copper when plating copper-nickel-chromium? You'll still provide the necessary rust-proofing—as so many users of Unichrome Pyrophosphate Copper Process are doing.

Thinner Deposits?

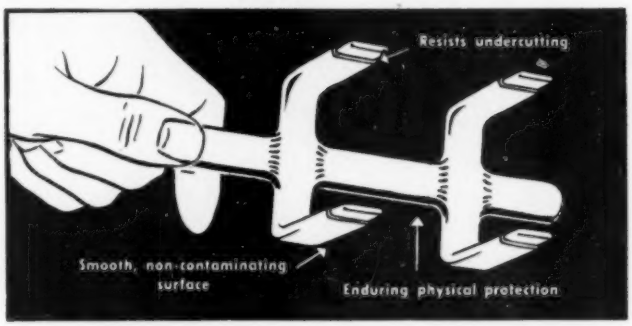
Thinner plate will be found suitable on many products not subjected to considerable handling, if the plated surface is reinforced by a clear lacquer or baked-on finish. Unichrome Clear Product Finishes have been used for years to protect chromium, copper, nickel, silver, brass and many other polished surfaces.

Use Zinc More

It's more plentiful than some metals, and it's inexpensive. When processed in Unichrome Clear Dip, zinc provides a sparkling, sales-appealing finish that looks like chromium and resists corrosion. Such a finish not only costs less, but actually provides better rust-resistance.

Unichrome Plastisol Proves to Be SUPERIOR INSULATION FOR RACKS

- *Because it helps to conserve plating metals*
- *Insures minimum rack maintenance*
- *Goes on faster, with less labor*



How does Unichrome Plastisol Coating 218X accomplish all this? First, it has great durability in all plating cycles; reduces wasteful metal build-up on racks. Second, it bakes into a smooth, glossy coating which rinses freely and helps cut dragout losses, often eliminating expense and delay of reracking for chromium. Third, the insulation withstands abuse. Tough, flexible and substantially thick, it won't tear or chip.

Furthermore, only a single coat of Unichrome Primer 219PX is employed with Coating 218X. Users have found that this system not only saves time, but also insures more lasting adhesion. There are no loose pockets to trap and carry over contaminants—(one of the reasons why Coating 218X is endorsed for leading bright nickels).

The United Chromium service organization will gladly give you full details on this rack coating system—and follow through to see that it is applied so as to deliver its usual long and economical service. Write for more details.

UNICHROME Trade Mark

UNITED CHROMIUM, INCORPORATED

100 East 42nd St., New York 17, N. Y.
Detroit 20, Mich. • Waterbury 90, Conn.
Chicago 4, Ill. • Los Angeles 13, Calif.
In Canada:
United Chromium Limited, Toronto, Ont.

THE MAILBOX

Subject: Spectrographic Analysis

DEAR SIR:

The purpose of this letter is to point out the superlative possibilities of spectrographic analytical methods in the plating field. The spectrograph should be used more widely in electroplating research and quality control.

When an element is heated in an electric arc, the atoms give off light of various wavelengths. The wavelengths produced by each element are unique and characteristic of that element. A spectrograph separates a beam of light into its component wavelengths and then photographs the spectrum. The intensity of the wavelength line on the photographic plate is a function of the concentration of the element producing the light. The relative intensity is measured by a photoelectric cell. By referring this relative intensity to calibration and working curves, the concentration of the element is determined.

An example of the importance of trace elements was shown in A. E. S. Research Project No. 5, which found that 0.05 per cent of copper in a Watts-type nickel bath reduced the salt spray resistance by 50 per cent. One company permits the following maximum percentages of allowable impurities in a Watt's nickel bath: copper 0.02, iron 0.1, and zinc 0.05. The percentages are in the concentration range, below 0.5 per cent, in which spectrographic analysis gives generally more accurate results than chemical analyses by wet methods.

Spectrographic methods have numerous *advantages* over wet chemical methods. They provide permanent records. They are much more rapid for routine analytical work, requiring perhaps one-fifth the man hours. In addition, many trace elements may be determined almost simultaneously. Since the cost of a routine spectroanalysis is low, a company can afford a greater number, and with closer control of solution composition, the quality of the deposits often improves. Some plating laboratories use the spectrograph for analysis of minor solution components, chemical methods for major constituents.

Spectrographic analysis of some elements is sensitive to 0.0001 per cent, and it differentiates between two elements which are chemically very similar. While chemical separation is not necessary, it is used in some cases to concentrate a particular element and thus improve the accuracy of the subsequent spectroanalysis.

The amount of material needed for analysis is very small, and spectroanalysis may in some cases be performed without destruction of the sample. Thus the electrodeposit from a very small area is needed for spectroanalysis, whereas chemical analysis often requires a large area. In trouble shooting, to find the cause for defective plating, a spectroanalysis can easily track down an unsuspected metal impurity that is responsible.

A spectrograph can be used in research in varied ways. For example, it can be employed to determine the location of adhesion failure by analysis of the deposit to find if it carries with it some of the basis metal. If not, it can be suspected that the failure of adhesion was at the electrodeposit-basis-metal interface. Sometimes the adhesion of an electrodeposit is related to the composition of the basis metal. In a zinc-base diecasting, a lead content above 0.007 per cent causes the alloy to be very active chemically and results in poor adhesion. A spectroanalysis easily reveals whether or not the lead content is above the maximum.

A spectrograph can be employed to test the purity of analytical reagents and plating-bath chemicals. A preliminary qualitative spectroanalysis will save time in a thorough quantitative chemical analysis.

Spectrographic methods are beset with certain *limitations*. Many nonmetallic elements cannot be easily determined with the spectrograph.

A prism-type spectrograph good for impurity analysis may cost $5,000. This high cost may be justified in a central research laboratory if a number of research groups pay a proportional share of the initial cost. If a large number of routine tests per day are required, the purchase of a spectrograph is likely to be profitable.

There is another answer to the high cost of the equipment. If the sample to be analyzed is a powder, an adequate sample may be mailed for three cents to a consulting spectrographic laboratory, of which there are several. While the sample may be very small, it should be representative and homogeneous.

Greater use of the spectrograph in the electroplating field, for research and control, is likely to lead to advances in the quality of electrodeposits and new and improved electroplating baths.

CARL POLLARD, *Chicago, Ill.*

Subject: Drag-in

DEAR SIR:

In attempting to make use of some of Kushner's excellent analysis of drag-in and rinsing on page 800 of the August, 1949 issue of PLATING, the writer observed a case when Kushner's simplification could be a trap for the unwary.

Reference is made to equations 5 and 6 of the cited article. Equation 5 expresses correctly and exactly the build-up of a contaminant in a plating tank from the previous rinse:

$$C_p = C_1\left[1 - \left(1 - \frac{\Phi n}{V_p}\right)^t\right] \qquad (5)$$

where C_p = concentration of contaminant in plating tank, in oz/gal
C_1 = concentration of contaminant in rinse (limiting value), in oz/gal
Φ = volume of drag-in or drag-out, in gal/sq.ft
n = number of sq.ft transferred per minute
V_p = volume of plating tank, in gallons
t = time, in minutes

The simplying assumption is then made that, since Φ is very small compared to V_p, the expression within the parenthesis can be expressed by $(1 - \Phi nt/V_p)$ and equation 6 is derived:

$$C_p = C_1 \Phi nt/V_p \qquad (6)$$

This simplification amounts to taking the first two terms of the expansion of the binomial series $(1 - x)^n$, that is $(1 - nx)$, as an approximation of the sum of the series, x being a very small number. This is valid only when n is a reasonably small finite number. As n approaches infinity, $(1 - x)^n$ vanishes, which in the present problem means only that the limiting impurity concentration in the plating tank becomes the same as its concentration in the previous rinse. The simplified equation 6, on the other hand, would make C_p infinitely large.

The only purpose of this note is to warn against the use of equation 6 when very large values of t are used. Note that this expression is linear in t and that when t times $\Phi n/V_p$ exceeds unity, C_p becomes larger than C_1, an obvious impossibility.

In his numerical example, Kushner finds that to build up C_p = 0.002 oz/gal (or C_p = 0.051 C_1) it takes 2550 minutes, using equation 6. Substituting 2550 minutes back in the exact equation 5, we find C_p = 0.0498 C_1, an error of only about 2.4 per cent. But if we were interested in the concentration after two or three months of operation, say 100,000 minutes, we find that the exact equation 5 gives C_p = 0.865 C_1, whereas the approximate equation 6 gives C_p = 2 C_1, which is not possible.

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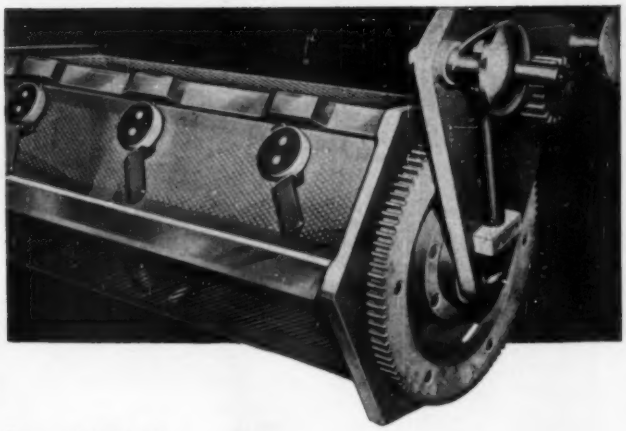

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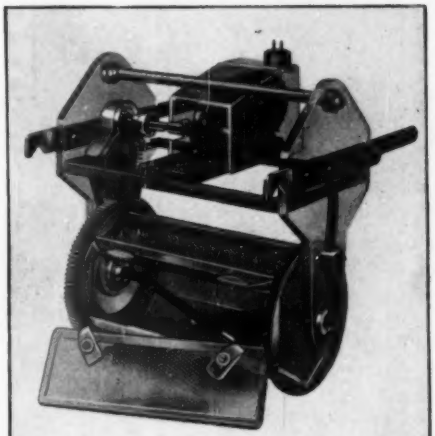

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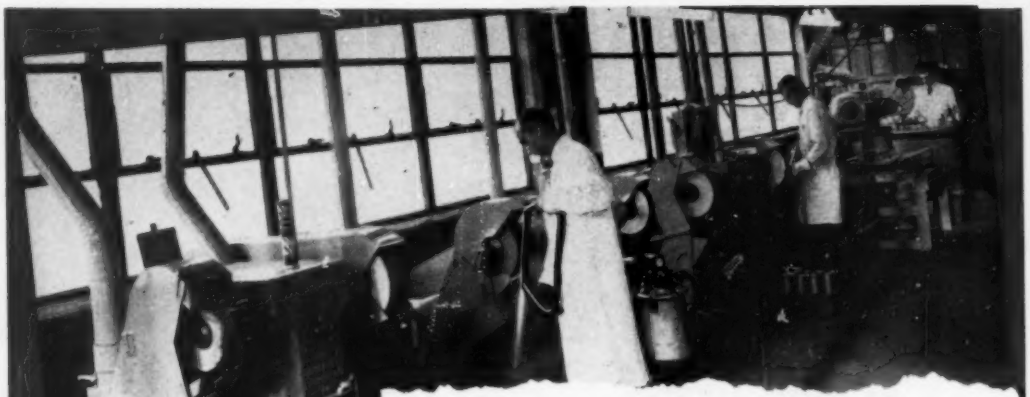

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Cover Picture, courtesy Aluminum Company of America

Published by the American Electroplaters' Society at 5800 N. Marvine Street, Philadelphia 41, Pa. Editorial, Advertising and Executive Offices: 473 York Road, Jenkintown, Pa. Phone: Ogontz 9650-1. Subscriptions: Domestic and Canada, $4.00 for 1 year, $7.00 for 2 years; 50c per copy; Foreign, $6.00 per year, 75c per copy.

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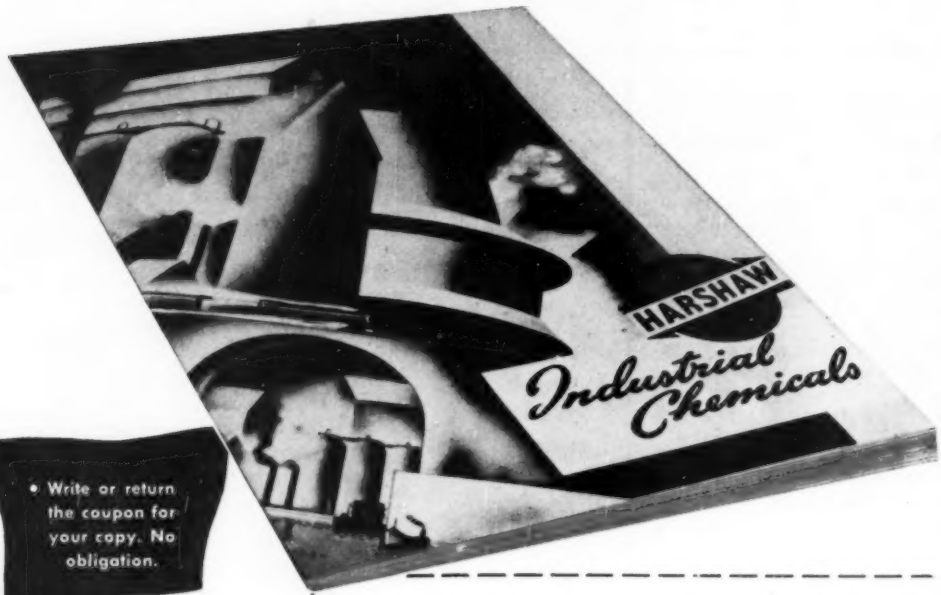

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Editorial

Still More About Seeing and Disbelieving

IN THE AUGUST AND SEPTEMBER issues we discussed two sources of difficulties encountered in the interpretation of data, namely, unconscious stretching of truths and failure to take into account systematic errors. We will now end this discussion by considering how one can be led astray by so-called accidental errors of observation.

It is well known that an average of several determinations is more reliable than a single determination. However, an average may be more or less precise. Suppose, for example, that hardness tests were run in quadruplicate and that average hardness values of 130 and 140 were obtained at 20 and 30 asf, respectively. At first glance one might say that the hardness is greater at the higher current density, and that would be true if the original readings within each set were very close together. But if the first set of readings were 110, 125, 140 and 145, averaging 130, and the second set of readings were 125, 140, 145 and 150, averaging 140, the conclusion becomes rather doubtful because of the substantial overlap. In fact, a Student t test (a statistical device) will show that there are only about two chances out of three that there is any real difference between the two sets of values. This is a very low confidence limit, 19 chances out of 20 being considered reasonable.

To increase the probability of correctness it is necessary either to refine the technique of preparing the specimens and measuring the hardness or to run a much larger number of determinations. The former is usually the better choice when laboratory tests are concerned, the latter when plant experiments are involved.

A great deal has been written about this general subject. Interested readers are referred to "A. S. T. M. Manual on Presentation of Data" for an elementary discussion of significance of data and to "Industrial Experimentation" by K. A. Brownlee, Chemical Publishing Company, Brooklyn, N. Y., for a rather detailed treatment of how to obtain significant data.

In order that one may put faith in the conclusions drawn from any data, it is essential that the conclusions are limited to the actual range of observation, that the description of the experimental method furnishes proof of substantial absence of systematic errors, and that averages are accompanied by evidence of their statistical significance. In the absence of any one of these criteria, the critical reader cannot help disbelieving what he sees until better evidence is forthcoming.

Gustaf Soderberg

SPECIFICATIONS FOR ELECTRODEPOSITED COATINGS

THEIR PURPOSES AND IMPORTANCE*

CLARENCE H. SAMPLE

The International Nickel Company, New York, N. Y.

It is perhaps natural that electroplaters should feel that specifications on electrodeposited coatings are written entirely for the benefit of the purchaser or consumer. While the consumer's activities in the field of specification writing are undoubtedly prompted by his own interest, the benefits to be gained from good specifications are by no means limited to him. Good specifications provide the means whereby the purchaser, with the assurance of the producer, can obtain what he requires at an equitable price and thus promote confidence in the industry. Further, good specifications promote confidence and understanding within the industry by directing competitive efforts toward efficiency and quality rather than toward cheap and shoddy work. Benefits to the consumer from such efforts are immediate, while the producer's long term reputation for good work is enhanced and his competitive situation unimpaired. Poor specifications, while probably written with the best of intentions, usually benefit neither the producer nor the consumer and may confuse the essential issues with resultant unnecessary delays and misunderstandings. Thus poor specifications are also of importance but only in their undesirability. It is important to both producer and consumer that poor specifications be eliminated or preferably never written.

By definition a specification is "a definite, particularized and complete statement". Its primary purpose, insofar as electrodeposited coatings are concerned, is to tell the plater or producer exactly what is wanted dy the purchaser or consumer and to describe methods of test whereby both parties can be assured that the product meets the requirements specified. In view of wide range of properties and many variations available in electrodeposited coatings, as discussed in a previous paper[1a], the necessity for specifications covering them will be apparent.

It will also be apparent that in order to prepare workable specifications, the purchaser must know precisely what he wants and be able to state to the producer his requirements and methods of test without ambiguity. Further, and of the utmost importance, there must be assurance on the part of the producer interests that the requirements of the specification can be met on an economically sound basis.

Good specifications are usually written only through the joint efforts of both producer and consumer. Through the producer, the consumer has the opportunity to learn the advantages and limitations of the process. He also learns what is and what is not feasible from the standpoint of production. Thus his requirements become reduced to a practical basis. On the other hand, the producer has an opportunity to learn from the consumer not only what is required today but what may be required tomorrow and is thus given an opportunity to consider ways and means of providing it.

The number and quality of specifications in a given field is an indication of its economic importance. The mere fact that specifications are written on electrodeposited coatings is evidence that such coatings can be produced in quantity with uniform properties and thus can serve a useful engineering purpose.

Types of Specifications and Importance of Tests

Specifications on electrodeposited coatings usually can be divided into two types, namely, (1) those which specify the process to be used, and (2) those which specify the requirements on the end product, i. e., the coating itself. Some specifications, however, may be a combination of both types. In general, the use of process-type specifications is confined to manufacturing organizations for the control of operations within their own finishing departments. Such specifications usually leave little or nothing to the imagination or ingenuity of the operator, all details of the cleaning and plating operations, as well as of the materials, being specified in the minutest detail. Specifications of the second type are of more general use. They are commonly referred to as material or product specifications and are usually the type involved in purchase contracts for plated coatings. Our remarks here will be directed principally towards specifications of this type.

In general, the usefulness of specifications on electrodeposited coatings depends upon the reliability and the practicability of the inspection tests specified. There should be good correlation between the results of such tests and the performance of the coating in the service for which it is intended. To date, the lack

*Presented at Wayne University, Detroit, Mich., on October 27, 1947 as a part of a Symposium on Electrodeposited Coatings

of suitable inspection tests has been a deterring factor in the writing of performance-type specifications on electrodeposited coatings.

Numerous researches have shown that the most important single factor affecting the protective value of electrodeposited coatings is their thickness. For that reason, requirements on the minimum thickness of electrodeposited coatings form the principal basis of most specifications covering them. It is recognized that other properties of electrodeposited coatings, such as the continuity, hardness, ductility, and adhesion, are also important factors in their performance, and in some instances requirements on them are incorporated in the specification. There is little doubt that requirements on those and other properties would be included more generally if suitable methods of test for them were available. The lack of such test methods has long been recognized by groups concerned with the writing of specifications on electrodeposited coatings, and it is encouraging to know that concerted efforts to develop and standardize suitable performance tests are currently underway.

Research Projects No. 3 on "Adhesion of Electrodeposits"[1], No. 6 on "Porosity of Electrodeposited Metals"[2], No. 7 on "Methods for Testing Thickness of Electrodeposits"[3], and No. 9 on "Physical Properties of Electrodeposited Metals"[4] of the American Electroplaters' Society's research program should be mentioned as outstanding efforts along these lines. Also, Subcommittee III on Performance Tests of A. S. T. M. Committee B-8 has active sections on Porosity Tests; Thickness Tests; Lustre Tests; and Hardness, Ductility and Adhesion Tests[5]. These sections are closely cooperating with the corresponding Project Committees of the A. E. S. Research Committee. The latter are concentrating their efforts on fundamental aspects of the problem, including the development of new tests, while the former are devoting their attention to the standardization of tests for use in specifications. It is to be expected that improvements in specifications on electrodeposited coatings will be made through the joint efforts of these two organizations.

During the early part of World War II, many general equipment specifications appeared with requirements on electrodeposited coatings which, if literally interpreted and strictly enforced by the inspectors, would have resulted in the rejection of most, if not all, of the equipment involved. The following requirements, for example, are taken from a widely used specification of the time and illustrate the importance of clearly stating the end point requirements of tests:

> "*All* brass, bronze, copper and steel parts, other than corrosion resisting steel, shall have, in accordance with good engineering practice, a suitable protective plating to resist salt spray. The plating or coating shall be *uniform* in thickness, possess good adherence, and the quality shall be such as to withstand a 200-hour 20 per cent salt spray test" . . . "without *any* signs of rust or corrosion appearing" . . . "The plating on *all* plated parts shall be *uniform* in thickness, possessive of good adherence and the quality and thickness capable of withstanding the salt spray test" . . . "*without evidence of rust, corrosion or other deleterious manifestations*".—(Italics by author.)

The absurdity of the above requirements is emphasized by the fact that the equipment covered by the specification was produced in large volume and that it performed satisfactorily in service even though the finishes applied could not meet the requirements as written. Unfortunately much needless confusion and unnecessary delays resulted from these requirements. Since, despite such requirements, it was possible to produce the necessary equipment which was accepted and used to advantage, it may be argued that the example illustrates the relative unimportance of specifications on plated coatings. However, it better emphasizes a lack of preparedness in perhaps a secondary but nevertheless important phase of our industry. The situation improved during the course of the war, but there still remains much work to be done.

Early Uses of Specifications

The date of the first use of specifications on electrodeposited coatings is not entirely clear. It is known that process-type specifications were used by a manufacturer of electrical equipment as early as 1911, at which time specific requirements on the thickness of the coatings to be applied were added to the specification. The earliest recorded thickness tests of electrodeposited coatings, conducted at the National Bureau of Standards for the purpose of checking conformance with federal specifications, were made in 1924[6]. Those tests were on silver plated tableware. The thicknesses of coatings on plumbing fixtures were first tested by the Bureau in 1929, electrical conduit in 1930, and hardware in 1931. The automobile manufacturers were also early users of specifications on electrodeposited coatings and, with their recognition of the importance of standardization of materials and test methods, were active in the work which finally resulted in the preparation of the present A. S. T. M.–A. E. S. specifications on plated coatings.

A. S. T. M.–A. E. S. Specifications

Prior to 1935 there were no standard specifications on electrodeposited coatings available for general use. In that year were issued A. S. T. M. Tentative Specifications A-164, A-165 and A-166 for electrodeposited coatings of zinc, cadmium, and nickel-chromium, respectively, on steel. These were followed with the issuance in 1939 of Tentative Specification A-219 on Methods of Test for Local Thickness of Electrodeposited Coatings. With the organization of A. S. T. M. Committee B-8 on Electrodeposited Metallic Coatings, in 1941, two additional Tentative Specifications were issued. These were B-141 on Electrodeposited Coatings of Nickel and Chromium on Copper and Copper-

Base Alloys and B-142 on Electrodeposited Coatings of Nickel and Chromium on Zinc and Zinc-Base Alloys. In 1943 two Tentative Recommended Practices were issued, namely, B-177 for Chromium Plating on Steel for Engineering Use and B-183 for Preparation of Low-Carbon Steel for Electroplating. These were followed in 1945 with Tentative Specification B-200 covering Electrodeposited Coatings of Lead on Steel and B-201 for Chromate Finishes on Electrodeposited Zinc, Hot-dipped Galvanized and Zinc Die-Cast Surfaces. During 1949 Tentative Recommended Practice B-242, for the Preparation of High-Carbon Steel for Electroplating, was added to the list*. The above specifications were prepared in cooperation with, and approved by, the American Electroplaters' Society. The significance of the various requirements included has been discussed thoroughly in a previous paper[7].

Most of these specifications still remain as tentative, which suggests probable revision prior to their advancement to standard. Obviously they are not perfect, and much is to be desired in the way of requirements and test methods for important factors other than those now included. They do, however, represent a start, and with the added knowledge resulting from current research and development efforts it is to be expected that the present specifications will be improved and new ones added to the list as required.

Organizations interested in materials standardization in other countries, notably Great Britain, Australia and New Zealand, have issued specifications on electrodeposited coatings, which in general closely parallel the A. S. T. M.–A. E. S. specifications.

Other Specifications

In the absence of suitable standard specifications most large purchasers of electrodeposited coatings developed their own specifications to cover their needs. These, for the most part, are similar in that the minimum thickness of the coating generally constitutes the principal requirement. Salt-spray-test requirements are included in some, usually for the purpose of checking on the continuity of electropositive coatings. In others, however, salt-spray requirements appear to be of major importance and are apparently intended to control minimum thickness of both electronegative and electropositive coatings.

In this connection, it should be emphasized that, at best, the salt spray test can only provide a rough indication of the relative thicknesses of the same kinds of electrodeposited coatings. Further, the results of the test may be entirely misleading if used without other supporting evidence to predict the relative atmospheric-corrosion behavior or service life of different coating systems[8,9]. When properly operated and controlled, the test has, however, proven useful as a routine-inspection tool for checking the general quality level of the same kinds of coatings on production items.

While in many instances it is essential for individual organizations to have their own specifications and test facilities, in others it is impractical for them to do so. In both cases,how ever, standardization of requirements for similar applications and of methods of test would be of great advantage and benefit to the industry as a whole. To promote such standardization is the primary purpose of A. S. T. M. specifications. It can be effected either by their direct use in commerce or by their use as a guide in the preparation of other specifications by individual organizations. Many good specifications on electrodeposited coatings are now in use, but it should be emphasized that in order for them to be meaningful and to serve their intended purpose in purchase contracts the product they cover *must be properly tested and the requirements enforced.*

Conclusion

Much has been accomplished in the electroplating industry through the preparation and use of specifications on electrodeposited coatings. Their first use truly marks the beginning of the conversion of electroplating from an art to a science. The writer of the first specification on electrodeposited coatings was indeed a pioneer. There were few factual data on the performance of coatings and few methods of test available for him to use. By comparison, the specification writer of today is richly endowed, and his store of knowledge is being enlarged constantly through the researches and other efforts of many individuals and organizations.

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*These specifications, together with Tentative B-117 Method of Salt Spray (Fog) Testing, have been published in a single volume, obtainable from A. S. T. M. Headquarters, 1916 Race Street, Philadelphia 3, Pa., or American Electroplaters' Society, Box 168 Jenkintown, Pa.

POLISHING and BUFFING

a literature review

James H. Lindsey
Dearborn, Michigan

This review covers articles and papers which were published during the five-year period 1944–1948. Every effort has been made to avoid modification or editing of the opinions expressed by the authors of these articles and papers, because it has been the aim to present a representative picture of current thought and practice rather than a single viewpoint. Manufacturers' literature, though an excellent source of information, has been excluded because complete files were not available.

During the period covered, the principal developments have been the introduction of sprayed liquid buffing compounds and the widening acceptance of abrasive belts and greaseless compounds. Up to the present time, however, with the exception of a paper by Eastman[3] in 1944, there has been no published effort to place polishing and buffing on a scientific basis. Indeed, many of the most authoritative articles are prefaced by a statement to the effect that, regardless of what the writer may say in subsequent passages, the final authority is still the experienced finishing foreman. To some degree this is as it should be, but the reader who is familiar with the progress in electroplating, accomplished in a large degree as a result of the development of suitable measuring sticks during the past 20 or 25 years, will undoubtedly agree that a similar approach to polishing and buffing would pay equal dividends. It is to be hoped that a review of the next five years will include articles of this nature.

Polishing

References: 2, 24, 28, 46, 52.

Polishing is defined as the smoothing of a metal surface by means of abrasive particles attached by adhesive to the surface of wheels or belts. The steps from coarse to fine polishing are classified as "roughing out," "fining," "oiling" or "greasing out," and "coloring." The function of the operation is the removal of tool and die marks and other surface imperfections to produce a relatively smooth and uniform finish. Successively finer abrasives are used to accomplish this purpose. The average polishing operation will remove about 0.0002 inch of metal, though specific cases may depart radically from this figure.

Set-Up Type Polishing Wheels

References: 8, 12, 14, 20, 26, 27, 28, 31, 33, 34, 40, 46, 49, 50, 51, 52, 54, 55, 58, 60.

The basic tool used in polishing is the set-up wheel, which may be of any one of a wide variety of materials. It may be of solid construction, discs cemented or otherwise joined together, or segments held together by suitable retainers. The particular construction will vary with the material used or with the use to be made of the wheel.

Polishing wheels vary widely in flexibility. The hardest, or least flexible, wheels are fastest cutting but generally result in a poorer finish than softer wheels. Flexible wheels are of course indicated where irregular surfaces are involved.

As will be discussed in greater detail in connection with buffing wheels, the important dimensions to be specified for polishing wheels are arbor-hole diameter, outside diameter, and width of face.

Canvas Wheels—A wide range of hardness and flexibility is obtainable in wheels composed of canvas discs glued, cemented, or sewed together. The discs may also be held together by means of wood screws placed in concentric circles, the rows of screws being removed, in turn, as the wheel wears down. The characteristics are varied by choice of the weight of canvas, by intermixing discs of differing weights, or, when maximum flexibility is desired, in combination with aggressive cutting, by sewing or quilting sections of canvas onto the wheels. Hardness may also be adjusted by varying the diameter of glueing, sewing, or cementing. These wheels are used with coarse abrasive heads for such operations as deburring castings.

Canvas used varies in thickness from 1/8 to 5/16 inch.

Buff Wheels—The most common and most adaptable type of buffing wheel is made by cementing buff sections together. As will be discussed in connection with buffing, the degree of hardness can be controlled by the stitching of the buffs. In addition, the number of plies per section can be varied on the basis that the larger the number or the size of glued joints, the harder the wheel; flexible cements can be used to increase flexibility; and the hardness can be increased or decreased by raising or lowering the pressure applied while the glue or cement is setting. The result is a wide range of characteristics which make this type of construction suitable for operations intermediate between the rough work of the canvas wheels and the fine polishing obtained from leather wheels.

Its chief disadvantage—the hard streaks caused by the edges of the glue layers—can be overcome by having the glued joints between the sections run in spiral, rather than in parallel planes.

Because of its flexibility, this wheel is well adapted to the polishing of irregularly shaped pieces, including the greasing-out of die castings where this is necessary. A second feature which makes this type of wheel well suited to irregular objects is the deep abrasive-bond penetration which materially improves retention of the abrasive on the wheel. It is important, however, that the cloth be unbleached and free from filler if maximum glue penetration is to be obtained. For very rough polishing on such parts as castings where wear and tear of the wheels is a big cost item, colored muslin is sometimes used because of its comparatively low cost.

The construction of a polishing wheel from buffs is a complex operation requiring a great deal of care. The individual buff sections are balanced statically and arranged in sets with the point of balance marked. This alignment of the sections is maintained while they are cemented together on a mandrel, cement being applied to both faces. The wheels are kept under pressure for 24 hours at room temperature, following which they are dried further for 24 hours at 160° F without pressure. They are bushed and marked for direction of rotation. The surface of the face is then contoured or raked to raise the nap and honed with a carborundum stone. Burning of the wheel by careless raking or stoning or failure to raise the nap will prevent proper bonding of the abrasive.

The balance of a polishing wheel, and this applies to all types, is important because of the hazard of running an unbalanced wheel at high speeds and because of the effect of such a wheel in contributing to operator fatigue and damage to the polishing lathe, the wheels, and the finish on the work. Balance is corrected by attaching suitable lead weights to the side of the wheel or by the use of balancing tubes and weights.

Leather Wheels—Wheels built up by cementing leather discs together are used for fine polishing, the exact characteristics being dependent upon the leather used. Oak-tanned *bullneck leather* wheels withstand heavy use on hardened steel tools, flat forgings, stove parts, and some brass parts. They should not be used with coarser grit than No. 120.

The porous, open grain of *walrus hide*, because of its resultant unique combination of resiliency and toughness, renders it particularly suited to fine polishing of hardened steel cutlery, small tools, and small-arms parts. Single discs may be obtained up to 1½ inch in thickness. Walrus-hide bobs use in jewelry work are not set up with a head in the usual manner but are charged with an oil-abrasive mixture applied to the parts.

Sheepskin wheels may be built by cementing together individual full discs or groups of sewed disc sections. The flexibility and relative softness of these wheels make them particularly useful for finishing of jewelry and such soft metals as brass and aluminum. Quilted sheepskin wheels are suitable for polishing of irregular surfaces.

Wood-Leather Wheels.—A thin strip of leather may be glued and pegged around the face of a laminated wood wheel, imparting resiliency (which may be varied by varying the leather thickness) while preserving the hardness. The resultant wheel is suitable for fine polishing of flat work on which sharp edges and bevels must be preserved: small tools, name plates, and parts of a similar nature.

Felt Wheels.—Because of their peculiar combination of resiliency and fast cutting, felt wheels are used where some metal must be removed but a high luster with freedom from deep scratches is desired. They should not be set up with coarser than No. 150 grit. Densities are obtainable from extra soft to rock hard, and the nature of the material gives it the ability to hold its shape, which makes it particularly useful for formed-face wheels and bobs. Solid wheels may be had up to 24 inches in diameter and 6 inches in face width, so that the disadvantage of hard spots resulting from glued construction can generally be avoided if desired. Otherwise these discs can be cemented or sewed together.

Felt wheels are particularly suited to use on brass and to some stainless-steel operations.

Close attention must be paid to the condition and operation of felt wheels, because they can be easily damaged by burning. Good balance is important, because the wheel will burn at any spot where the head is worn through.

Compress Wheels.—The compress wheel consists of resilient segments held radially between two clamping plates riveted together and mounted on a steel hub. The segments may be of practically any material, although bullneck leather and canvas have the greatest usage. By varying the dimensions, number, and material of the segments one can obtain a range of densities, from super soft to super hard. There are no hard spots due to glue and no separations in the plane of rotation. The face is absolutely uniform and wears

well; hence these wheels are particularly adapted for formed-face wheel work. The fact that only end fibres are presented at the face ensures adequate and uniform penetration of glue during the preparation of the head. Where the need is sufficient to justify its somewhat high cost, this wheel merits close investigation.

Wheels of this type, with segments made from canvas, leather, or rubber, have been found well suited to use as contact wheels for abrasive belts in certain types of operations. The cushioning effect of the wheel permits the belt to conform to the surface of the work while providing a firm backing for positive belt drive and at the same time preventing glazing and premature belt wear.

Heading of Polishing Wheels

References: 6, 10, 12, 16, 19, 26, 27, 32, 46, 47, 51, 52, 55, 58, 59, 60.

The application and bonding of the abrasive to the wheel is an important subject which is treated in considerable detail. The adhesive may be animal glue or a silicate-of-soda-base cement. By far the greater part of the literature dealing with this subject is concerned with animal glue, reflecting the preponderant use of this material. It is suggested that the choice of adhesive be made on the basis of grit size, it being one writer's contention that cement should be used for grit sizes from No. 36 to No. 120 for sake of economy, whereas animal glue should be used with the finer grades because it results in a finer finish. Cemented wheels will stand higher temperatures than glued wheels, and this may also bear on a particular application. Sodium silicate cements are the basis of greaseless compounds, which will be discussed later in this review.

Adhesive Cement.—In heading a wheel with cement, one first applies a thin sizing coat. The cement used should be formulated for this purpose so as to secure maximum penetration into the wheel. Because this adhesive sets relatively fast, precautions must be taken to avoid its premature hardening. The temperatures of wheel room, wheels, and abrasives are important, as is the necessity for cooling the wheels thoroughly between coats. In these particulars, as well as in use, the manufacturers' recommendations must be followed closely.

Glue.—The requirements of glue are toughness, flexibility, high melting point and strength, all of which are characteristics of animal glues. It is of course necessary to purchase from a reliable source, and frequent changing of sources must be avoided. Since the strength of glue is reduced by bacterial attack, it is important that the temperature of the glue be held below 150° F at all times, and that suitable antiseptic precautions be taken in its handling.

Since the concentration of the glue determines, in part, the productive life of the polishing head, this factor should be held closely so that the maximum cutting edge, compatible with safe retention of the grain, be presented. When the cutting edges have been worn down to the glue surface, the wheel is said to be "glazed," and although it can be "sharpened" by rotating it against a steel brush, the depth of cut is reduced, and polishing cost increases. It is therefore usually a fallacy to consider it economical to use high glue concentrations simply because they permit more "sharpenings." The glue concentrations in Table I are recommended by two authorities. It will be noted that there is little difference between the two recommendations, and it should be borne in mind that some variation may be required to suit local conditions. Such variations should, however, be held to a minimum.

TABLE I. RECOMMENDED GLUE CONCENTRATIONS FOR POLISHING-WHEEL HEADS

Authority	Grit Size No.	Concentration of Dry Glue % by wt
G. A. Lux[6] (Divine Brothers Co.)	36	45
	46	40
	60	35
	90	33
	120	30
	150 & up	25
H. B. Sweatt[16] (Animal Glue Information Service)	24– 35	50
	46– 54	45
	60– 70	40
	80– 90	35
	100–120	33
	150–180	30
	220–240	25

Water used for the initial soaking of the glue should be as cold as is obtainable and never above 60° F, because swelling of the glue, which facilitates its solution upon subsequent heating, proceeds faster and to a higher degree in cold water. The glue must be thoroughly mixed in *clean* equipment, and all of the glue must be submerged in the water. Soaking will take from one to two hours for ground glue, from six to eight hours for flake glue.

The soaked glue is passed into solution by heating it close to but not over 140° F in thermostatically controlled pots. The temperature is important in order that loss of strength due to bacterial growth and overheating be avoided. At higher temperatures the glue breaks down, through successive stages, into proteose, peptone, and, finally, amino acids. The resultant loss in strength can be appreciable: at 200° F it is 14 per cent after 2½ hours, 29 per cent after 5 hours, 42 per cent after 7½ hours, and 53 per cent after 10 hours. To avoid such strength losses, glue should be made up only in small batches, and what remains of a batch at the end of a day should be discarded.

Sizing.—After a new polishing wheel has been trued and dressed by rotation against an abrasive brick or

sand paper, two coats of thin glue (18 per cent dry glue by weight, in water, is recommended) are applied, each coat in turn being dried and sanded smooth. This sizing provides a receptive base for adhesion of the glue coat which will hold the abrasive. The viscosity of the glue is important: glue which is too thin will penetrate too deeply, resulting in loss of flexibility; if it is too heavy, the bond to the wheel will be inferior.

It is not necessary to resize for reheading, unless the original sizing coat has been cut through, in which case the old head must be completely removed by means of an abrasive brick or diamond tool in a dressing machine, or, less desirably, by soaking in a wheel-washing machine. Failure to remove an old head before reheading may result in a relatively hard wheel.

Abrasives.—The abrasive used is, of course, of basic importance. The requirements are extreme hardness coupled with toughness and retention of sharp cutting edges; uniformity of grain size, crystal structure, and chemical composition; high capillarity to allow easy wetting by the glue; and surfaces suited to bonding with glue. These requirements are met by electrically fused and treated alumina, which is available in a wide variety of grades and grain sizes. Silicon carbide is also used. Some turkish emery is used but cannot be controlled with respect to the properties mentioned above. Emery is not suitable for stainless steel because of the danger of discoloration. Some rouge is used in fine polishing.

Sizes of grit used for roughing usually range from No. 60 to No. 80; for dry fining from No. 90 to No. 120; and for finishing from No. 150 to grits finer than No. 200. The grit to be used on a particular job will depend upon the size of the marks and scratches to be removed and upon the finish desired. It should be noted that too large a jump in grit sizes in successive operations is usually not economical and may result in "fish tails" during buffing.

Application of Head.—In preparation for heading, the sized wheel and the abrasive grain should be heated in the neighborhood of 100° F to prevent chilling, and consequent poor adhesion, of the glue. The grain should be held in a trough which is long enough to allow a complete revolution of the glued wheel. Ideal conditions call for a room temperature of about 80° F and relative humidity between 45 and 55 per cent.

In the actual heading operation, speed is of prime importance if the full load of abrasive is to be picked up. The wheel is rotated while the glue is being brushed quickly and uniformly on the face and is then transferred immediately to the grain trough, through which it is rolled with firm and uniform pressure.

Chilling, or too rapid jelling, of the glue is the difficulty most commonly encountered during heading. It results in reduced grain pickup and poor adhesion, with resultant poor performance of the wheel. Causes include low water content of the glue, delay in applying the grain after the wheel has been glued, light glue spread, low room temperature, insufficient pressure during the application of the abrasive, or air drafts. Other faults which may be encountered are a lack of sufficient glue on the wheel and premature drying due to overheating.

Before the usual second coat is applied, the first coat must have been allowed to set long enough to avoid being disturbed, yet not long enough to prevent bonding of the two coats. For fine grains, 15 minutes will be sufficient; coarse grains will require 30 minutes.

In the drying of the head to develop the strength of the glue, heat is of little use because the mositure must be removed in depth. Storage for 48 hours at 70–85° F and relative humidity of 50 per cent is recommended. In placing the wheels in storage, it is good practice to arrange them with the finer grains on top, so as to avoid ruining these wheels with coarser grits falling on them from other wheels.

"Breaking-in" the Wheel.—In order to retain the flexibility of the leather or fabric polishing wheels, which would otherwise be lost due to the unyielding nature of the abrasive-glue layer, it is customary to soften the wheel head by breaking, or cracking, it before use. This is done by striking the wheel a series of blows around its periphery with a 1½-inch pipe at an angle of about 45° to the axis of the wheel while it is stood on edge on a flat solid surface. The cracking is repeated with the pipe held at 90° from its firs position so that an X is formed with the first series of cracks. For very fine work, the wheel may be stoned in addition.

Special Polishing Wheels

Reference: 34.

Wheels are available which do not require set-up heads. In one type, sometimes used as a drum for polishing stainless-steel strip or sheet, a cushioned wheel carries means for clipping a cloth abrasive strip around its periphery. This construction lends itself to fast changing.

Wheels made of various types of resilient materials impregnated throughout with abrasive are also available. Such wheels are particularly suitable for use with portable tools. Among the materials are rubber, cotton fiber, and fiber resinoid.

Abrasive Belts

References: 9, 13, 17, 18, 21, 29, 36, 40, 47, 48, 50, 60.

The development of abrasive belts of closely controlled quality and of equipment for applying them (notably the development of back-stand idlers) has given strong impetus to this means of polishing. Very fine finishes are attainable, usually at a higher cutting rate than is possible with polishing wheels.

The application of abrasive belts may be classified under two headings: (1) those in which the belt is used to supply an air-cooled, uniform, and relatively long-lived head to a polishing wheel, usually of the

compress type; (2) those in which the flexibility of the belt is the major factor in its utility.

In the first classification we find the back-stand idler which serves to apply tension to a belt passing over a polishing wheel mounted on a polishing lathe, which may be of either the bench or pedestal type. Swing-frame abrasive grinders are similar in principle but carry the belt and wheels on a balancing frame which may be swung in any direction to facilitate the grinding, surfacing, or other processing of large castings, plates, or forgings. Available refinements are leather belts to provide additional resiliency to abrasive belts mounted over them and platens to back up the flat portion of the belt to permit the production of true surfaces.

In the second group we find small spindles used to produce small radii or to permit the polishing of recessed sections and holes. Belt-supporting platens of suitable radius can be used to produce concave surfaces of accurate radii. Such machines are widely used for the deburring of die castings.

By use of waterproof belts, most of these machines can be run with a coolant, resulting in longer belt life, decreased loading of the belts, and better dimensional control of the work. The coolant is applied to the belt just before it engages the work and again immediately after contact to flush away the metal chips and abrasive from the surface of the belt.

Coupled with close control of abrasive-grain size, the improvement in quality resulting from the electrostatic application of the abrasive to the belts has been one of the principal factors in expanding the use of these tools. In this method of belt manufacture, the glue-coated backing is passed over a traveling and parallel belt onto which abrasive grain is fed uniformly from a hopper. As the two belts pass through an electrostatic field (the glued backing being adjacent to the positive pole), the abrasive is attracted by the force of the field and imbeds itself into the glue. The result is a uniform abrasive surface which can be reproduced exactly at any time. The evenness of the surface is such that with certain machines tolerances can be held in the region of 0.0005 inch. Such belts are much more satisfactory than those headed in the same manner as polishing wheels.

The abrasives are the same as on set-up wheels.

Backing materials must be sufficiently tough to withstand the flexing and heavy pressures and must be woven tightly enough to prevent the abrasive grains from being forced into the backing. All backing materials are treated to resist stretching. Belts are available in a wide range of flexibilities, maximum flexibility being necessary for use over small-diameter spindles.

Polishing Compounds

References: 12, 26, 27, 39, 40, 46, 47, 48, 55, 60.

"Dry" abrasives have the highest cutting efficiency and are always used where considerable metal is to be removed, whether by abrasive belts of by set-up wheels. By cushioning the abrasive with grease, however, the depth of cut may be reduced and a better finish and luster produced. Particularly with grit of the finer sizes, lubricants are used to prevent loading of the abrasive surface, to prevent overheating, distortion, or discoloration of the work, and to extend wheel or belt life.

Emery paste, tallow-grease stick, emery cake or a combination thereof may be used for steel polishing. The addition of charcoal to the grease stick is suggested as a means of obtaining a brighter finish. Emery cake is sometimes preferred over tallow because of its heavier body and higher melting point.

Die castings and aluminum parts must be greased fairly heavily, otherwise the low melting points of these metals will result in a rough, "pulled" finish.

Polishing Speeds

References: 2, 14, 18, 20, 22, 26, 27, 39, 47, 50, 52, 56.

Because there is considerable difference of opinion as to the correct surface speed for polishing, undoubtedly reflecting variations in practice and materials, all published figures have been listed in Table II.

Relation of Polishing to Service Life

References: 15, 23, 43.

There has been considerable interest in the effect of the polished basis-metal finish on the life of subsequently deposited electroplated coatings. Studies made in 1945 by the National Bureau of Standards in cooperation with the American Electroplaters' Society led to the conclusion that over a wide range of polished finishes on steel the life of electroplated coatings was not a function of the finish, provided a

TABLE II. PUBLISHED POLISHING SPEEDS

Metal	Polishing Speed—surfact feet per minute
Not specified	7,500[2]; 6,000–8,000[12]; 6,500[14]; 4,500 for coarse grit, 6,500 for No. 80 grit and finer[18]
Aluminum	6,000[20, 39, 56]; 6,000–7,500[47]
Carbon steel	7,000–8,000[56]
Copper alloys, including brass	6,800[47]; 4,300–5,700[50]; 7,000[56]
Nickel	8,000[56]
Stainless steel and monel	7,000[22]; 9,000[26, 27, 47]; 5,000–9,000[52]; 8,000–9,000[56]
Zinc	5,000–10,000[47]; 6,000[56]

high grade of cold-rolled steel, free from oxides and other inclusions, were used. It was agreed that this need not conflict with previous findings that highest corrosion resistance of electroplated coatings applied over hot rolled or commercial cold-rolled steels was obtained with the finest polishing of the steel. This point is, however, still open.

As a sequel to this work, Research Project No. 4 was set up by the American Electroplaters Society to make a similar study on nonferrous metals. Tests are now in progress.

Greaseless Compounds

References: 1, 5, 13, 26, 27, 28, 30, 51, 60.

In the production of stain finishes, greaseless compounds have now reached wide acceptance. Such compounds, in which a sodium silicate-base cement is the vehicle for the abrasive, have been used in bar form for a number of years. They offer the advantages of flexibility and uniformity, as well as simplification of subsequent cleaning operations. In general, lower wheel speeds are used with greaseless compounds than with more orthodox materials.

The compound is applied to the wheel or belt travelling at low speed, then dried for two minutes with the abrasive surface at full speed. By application of a second coat in the same manner, a 3/16-inch head can be readily built up.

One author reported difficulty arising from the evaporation of volatile constituents, particularly in hot weather, resulting in hardening of the compound. This was overcome by storage at temperatures slightly below room temperature. A more serious difficulty—slow hardening of the material on the buffs in hot, humid weather—was solved by lowering the storage temperature to −20° F and allowing sufficient time for the bars to reach this temperature throughout. Frictional heat upon application to the buff melted the compound at a rate and under conditions which promoted fast charging and setting. Use of this procedure resulted in a 37 per cent saving of material and an unreported saving in man-hours—sufficient to permit quick amortization of the necessary refrigerating equipment.

To avoid such difficulties and to provide more economical operation, the Siefen Company developed its "Nu-Spra-Glu" process of spraying a mixture of binder and abrasive on the wheels or belts. In this process the cement-abrasive mixture is fed from a pressure pot to a suitably positioned, foot-controlled spray gun which sprays the compound on the wheel. The thickness of the head is increased with the severity of the operation, and abrasives can be used in grain sizes from No. 80 to No. 600. By means of automatic valves the process can be applied to automatic machines.

Because of the light head usually used, it is essential for good adhesion between abrasive and wheel that the work be free from grease or oil and that heavy pressures and high speeds be avoided.

Cements of this type may now be had from several sources, and in as much as there is a wide variation in available properties, the recommendations of the manufacturer should be followed closely.

(To be Continued)

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DUCTILE, MIRROR-BRIGHT COPPER PLATE FROM ACID SULFATE BATHS

Part II. Pilot-Plant Operation and Application

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Introduction

This part of the paper deals with the application of the three individual addition agents described in Part I to bright and semibright plating. Practicable control methods are described herein based on data obtained during pilot-plant operation of a 100-gallon tank for over 200 amp-hr/liter (758 amp-hr/gallon) and evidence that usefulness thereafter was indefinitely long. The procedures are adaptable to commercial plating of bright copper having mirrorlike color and heretofore unequalled properties. Savings are visualized by bright-copper plating before bright-nickel plating, because the "double-plated mirror finish" needs no coloring before chromium plating and "scratch hiding" is improved.

The Bright Copper Process

The general procedure for producing smooth, ductile, mirror-bright copper plates is similar to that used for copper plating from sulfate solution. The same equipment can be used, except that additional generator or rectifier capacity may be required, since preferred current densities are higher for bright copper. Any conventional procedure for cleaning and copper striking in preparation for acid copper plating may be used in preparation for bright copper.

The New Brighteners

The new brighteners are as follows‡:

No. 1. The sodium salt of sulfonated di-para-tolyl sulfide

No. 2. Sulfonated di-para-tolyl disulfide

No. 3. Sulfonated di-para-tolyl sulfoxide

For simplicity in reference hereafter in the paper, these three brighteners will be referred to, respectively, as the sulfide, the disulfide, and the sulfoxide.

Brightener control is similar to that used for many bright-nickel baths. Where ordinary copper-plating procedures are modified, the changes incorporate techniques familiar to bright-nickel platers. Bath formulation and operating conditions are as follows:

Solution Composition

	Maximum	*Minimum*	*Preferred*
Copper sulfate ($CuSO_4 \cdot 5H_2O$), g/l	275	200	240
oz/gal	36.8	26.8	32
Sulfuric acid (H_2SO_4), g/l	10	75	90
oz/gal	14.7	10	12
Sulfide, g/l	0.9	0.6	0.8
oz/gal	0.12	0.08	0.107
Disulfide (1 per cent solution in dilute acid)			
g/l	16.0	8	12
% by vol	1.6	0.8	1.2
Sulfoxide (ditto), g/l	30	15	20
% by vol	3.0	1.5	2.0

Operating Conditions

	Maximum	*Minimum*	*Preferred*
Temperature, °C	40	27	38
°F	110	80	100
Cathode current density (average), amp/dm²	10.8	5.4	10
asf	100	50	75
Anode current density, amp/dm²	4.3	No Limit	4.3 (or less)
asf	40	No Limit	40 (or less)

The brighteners are sulfonated to make them soluble in water. The disulfide and sulfoxide are not separated from the excess sulfuric acid used for sulfonation but are only diluted for storage and shipping. The sodium salt of sulfonated di-p-tolyl sulfide has excellent stability. A very small amount of material in the sodium salt is insoluble in water (or in the plat-

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†Wyandotte Chemicals Corporation, Cleveland, Ohio, formerly Battelle Memorial Institute, Columbus, Ohio.
‡Preparation of these brighteners is described in Part I, published in the October, 1950 issue.

Fig. 1. Sketch of front outer bumper bar showing approximate locations where thickness of bright copper was measured

ing bath), and to avoid slightly rough plates from a new bath, bath filtration after the addition of brighteners has been found desirable. In an aged bath, requiring a relatively large amount of the sulfide, it is desirable to dissolve the salt in water and filter the solution before adding it to the bath.

No "break-in", or "dummying", period was required for a new bath. Slight adjustments in brightener concentrations were sometimes necessary to bring out uniformly mirror-bright plate on various parts with differing shapes.

Control of bath temperature was found to be important. While variations between the limits of 80° and 110° F were permissible, a change of more than 5° F required a slight brightener adjustment. Mirror-bright plates were not obtained at temperatures exceeding 110° F. At 120° F the plate was fine grained, but there was no luster or reflectivity. Treeing at high-current-density edges was encountered at 80° F or less. Thus, unless edges were "robbed" or guarded from very high currents, a temperature of 100° F was preferred. Even at this temperature, racks were designed to avoid unguarded corner projections in order to circumvent treeing.

Anode current densities in excess of 40 asf resulted in excessive anode polarization. On account of sludge, anodes were bagged to prevent nodular deposits. Best results were obtained with sacklike bags that enclosed several anodes hung edgewise toward the work. These bags were made from double thicknesses of Vinyon 13*. Both electrolytic- and rolled-copper anodes were used successfully.

The bright-current-density range was found to be approximately from 25 to 150 asf when the work was supported from a work bar reciprocating with a 4–8-inch stroke at 15–30 cycles/minute. When the work was stationary, the bright range was not so wide, approximately from 25 to 100 asf, and the degree of brightness was reduced. An average cathode current density of 100 asf was practical on parts where the current distribution ratio between the highest-and-lowest-current-density areas did not exceed 2:1. However, an average current density of 75 asf was desirable for most parts.

Continuous filtration was essential during continuous operation, because brightener decomposition products are insoluble and serve as nuclei for nodules. A

TABLE I. DISTRIBUTION OF PLATE ON THREE FRONT OUTER BUMPER-BAR SECTIONS*

Location	Plate Thickness†, inch, on Bar No.		
	1	2	3
A	0.00110	0.00130	0.00190
B	0.00110	0.00137	0.00180
C	0.00090	0.00137	0.00180
D	0.00070	0.00095	0.00150
E	0.00060	0.00105	0.00160
F	0.00065	0.00100	0.00155
G	0.00120	0.00230	0.00380
H	0.00150	0.00210	0.00340
I	0.00070	0.00080	0.00130
J	.....	.....	0.00130

*Sketch of section shown in Fig. 1.
†Determined by Magne-Gage.

filtration rate of 0.01 gallon/minute per gallon of plating solution was found to be satisfactory. Filtered solution re-entering the plating tank was directed away from the anodes in order to avoid disturbance of any anode sludge in the bags. Periodic filtration was satisfactory for intermittent operation, but in this case solution depth between the bottom of the work load and the bottom of the tank was ample to prevent deposition of rough plate.

The effects of impurity metals were not investigated quantitatively. Some impurities, such as iron, that were encountered during pilot-plant operation, were without apparent effect.

Due to polarization effects on high-current-density areas, throwing power of acid copper was improved by the use of the brighteners described herein. Although no quantitative measurement of throwing power was made for comparison with other baths, the plate-thickness distribution on a Cadillac bumper section, Fig. 1 and Table I, illustrates the results obtained.

Cathode efficiency is essentially 100 per cent. Thus the time-current relationships worked out for any 100 per cent cathode efficiency acid-copper plating bath can be used for bright copper plating.

Deposits over dull or mat surfaces did not become mirror bright until at least 0.0003-inch thickness had been built up (4–5-minute plating time at 75 asf). Thicker plates had better hiding power, as well as better mirror reflectivity.

A Semibright Copper Bath

During the work with mirror-bright plates, it was found that smooth, semibright deposits were obtained from a bath containing only sulfonated di-p-tolyl sulfoxide. Scratch-hiding power, while not as good as that of fully bright plates, was sufficiently good to

*Wellington Sears Company, New York.

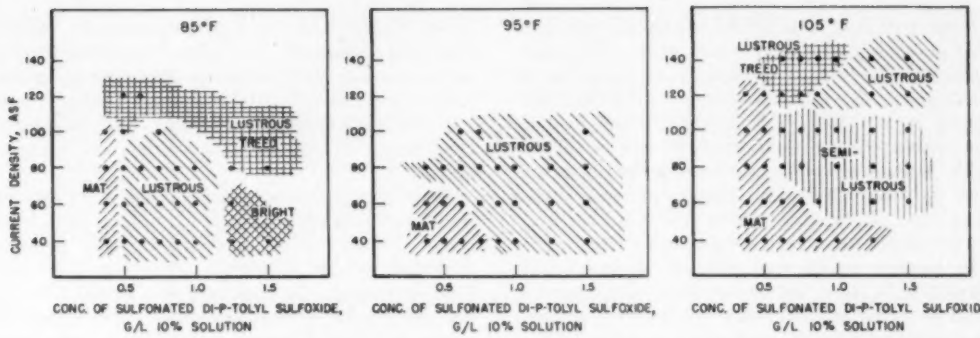

Fig. 2. Conditions for obtaining about 0.0015 inch thick smooth lustrous, or semibright, deposits on cyanide-copper flashed 1¾ x 5 inch steel panels from a bath containing 250 g/l $CuSO_4.5H_2O$ and 110 g/l H_2SO_4. Panels were moved 20 cycles per minute with a 2.6-inch stroke, and baths were air-agitated

serve as a basis for bright nickel when the base metal had been polished to a good smooth finish. Semibright plates were easily color buffed, showing much less "wheel drag" than molasses-type copper plates, and exhibited exceptionally good electrobuffability.

Variations in operating conditions are shown in Fig. 2. Smooth, lustrous plates were obtained at current densities up to 140 asf. Subsequent work, at still higher current densities (and with higher rates of agitation) indicated that this brightener could be used, efficaciously, for grain refinement in "high-speed baths". The bath with three brighteners, producing mirror-bright plates, does not appear promising for deposition rates exceeding 0.005 inch/hour.

Brightener Control for Mirror-Bright Plates

Total brightener concentration could be varied over wide limits with no significant variations in results. For example, the maximum recommended concentration could be doubled with no ill effects, except increased brightener dragout. However, the ratio of the three brighteners had to be held within narrow but operable limits in order to produce smooth, fully bright plates. The permissible limits for variations in concentration of sulfide, relative to the concentration of the other brighteners, were the narrowest and found to be as follows:

Sulfide	2–3
Disulfide (1% solution)	40
Sulfoxide (1% solution)	70

Departure from the optimum ratio produced plates such as those described in Fig. 3. This chart was used

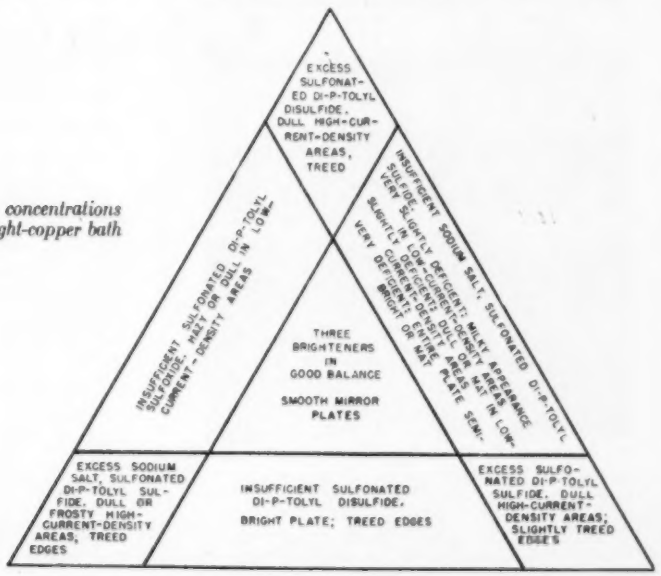
EXCESS SULFONATED DI-P-TOLYL DISULFIDE. DULL HIGH-CURRENT-DENSITY AREAS, TREED
INSUFFICIENT SULFONATED DI-P-TOLYL SULFOXIDE. HAZY OR DULL IN LOW-CURRENT-DENSITY AREAS
INSUFFICIENT SODIUM SALT, SULFONATED DI-P-TOLYL SULFIDE. SLIGHTLY DEFICIENT: MILKY APPEARANCE VERY SLIGHTLY DEFICIENT: SLIGHTLY DULL IN LOW-CURRENT-DENSITY AREAS VERY DEFICIENT: DULL OR HAZY IN LOW-CURRENT-DENSITY AREAS, MAT IN LOW-CURRENT-DENSITY AREAS, SEMI-BRIGHT OR MAT ENTIRE PLATE
THREE BRIGHTENERS IN GOOD BALANCE
SMOOTH MIRROR PLATES
EXCESS SODIUM SALT, SULFONATED DI-P-TOLYL SULFIDE. DULL OR FROSTY HIGH-CURRENT-DENSITY AREAS, TREED EDGES
INSUFFICIENT SULFONATED DI-P-TOLYL DISULFIDE. BRIGHT PLATE; TREED EDGES
EXCESS SULFONATED DI-P-TOLYL SULFIDE. DULL HIGH-CURRENT-DENSITY AREAS; SLIGHTLY TREED EDGES

Fig. 3. Effects of relative brightener concentrations on appearance of deposits from the bright-copper bath

to correct off-color deposits by appropriate additions after a visual examination of the work. The chart shows that a very slight deficiency in concentration of sulfide produced a milky appearance in low-current-density areas. While this appearance may not be acceptable for decorative bright copper as a final plated finish, it was satisfactory as a basis for bright nickel, since the color of the final bright nickel over these areas could not be distinguished from the color over areas covered with a mirror-bright copper deposit.

In general, sulfide and sulfoxide in insufficient amounts or in excess had similar effects on appearance of plates. Dull or hazy plates in low-current-density areas indicated a deficiency of one or the other brightener. The effect of an excess could be first seen on high-current-density areas. However, the change in concentration that produced a visible effect was considerably different for these two compounds. Concentration of sulfide outside the limits of 0.6–0.9 g/l resulted in "off-color" plates, but 1 per cent sulfoxide could vary from 15 to 30 g/l without visible effects.

The results produced by an excess of disulfide were not clearly established. Sometimes, a large excess produced no visible effect. At other times during continuous operation when an excess was known to be present, an unusual tree could be seen on thick plates (0.001 inch or more) in high-current-density regions but never immediately over edges. Since this became noticeable only after several ampere-hours per gallon had passed through the "off-balance" bath, it was ascribed to a decomposition product of the brightener when present in large excess rather than to the brightener itself.

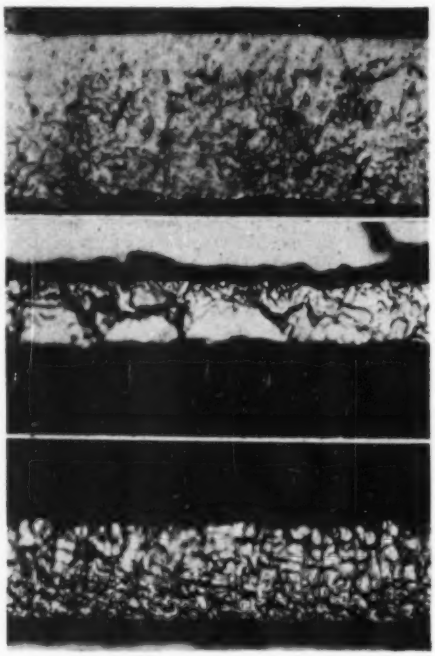

Fig. 4. Photomicrographs of as-deposited bright copper (top), semi-bright copper (middle), and molasses copper (bottom). 750X. Etchant: 5 parts 28 per cent ammonium hydroxide, 3 parts 3 per cent hydrogen peroxide, and 5 parts water

Total brightener concentration could be determined by a potentiometric oxidation titration with ceric sulfate. Analytical methods for estimating the concentration of the individual brighteners have not been developed, since plating is controlled easily and quickly by bent-cathode tests. The effects of large and small changes in brightener ratio were evaluated with 1 x 4-inch steel strips bent into half cylinders around a $\frac{5}{8}$-inch-diameter rod. Brightener additions needed to restore a good balance were determined empirically. The detailed information that was obtained from this investigation was successfully applied to the control of pilot-plant operations. Brightener content for the semibright bath was controlled by ceric sulfate titration.

Brighteners can be removed completely by treating the bath with activated carbon. The sulfide is (slowly) oxidized by air, hence air agitation was not used.

Rates of consumption, including dragout and filtering losses, during 200 amp-hr/l of pilot-plant operation for processing bumper-bar sections and fender guards (0.001-inch plates) were as follows:

Sodium salt, sulfonated di-p-tolyl sulfide	0.007 g/amp-hr
Sulfonated di-p-tolyl disulfide (1 per cent solution in dilute acid)	0.2 g/amp-hr
Sulfonated di-p-tolyl sulfoxide (1 per cent solution in dilute acid)	0.1 g/amp-hr

These rates may appear high in comparison with those for other brighteners. It should be remembered, however, that the figures for the disulfide and sulfoxide refer mostly to weight of excess sulfuric acid and water present in the final sulfonation mixture.

Plate Properties

The ductility of the mirror-bright copper plate is good and scarcely distinguishable from ductile mat plates deposited in the usual copper sulfate bath. Cold-rolled steel sheet plated with 0.001-inch bright copper could be bent back on itself (180°) over a 1/32-inch radius (as on a bending brake) without cracking of the plate. Ninety-degree bends over a much smaller radius could also be made without visual evidence of cracking. A threefold increase in total brightener content, with addition agents in the proper ratio, did not adversely affect ductility, but an excess of the sulfide caused the plates to be slightly brittle. The ductility of semibright or lustrous plates produced with only one brightener was equally as good as that obtained in the bright-plating bath with brighteners in good balance.

(*Continued on page 1161*)

SUMMARY

Existing methods for determining trivalent chromium in chromic acid plating baths are inaccurate, slow and tedious, or require potentiometric equipment. The new method described here does not suffer from these drawbacks. The trivalent chromium is precipitated as a double sodium chromic fluoride from a solution having a pH of about 5 and saturated with sodium fluoride. After filtration, the precipitate is washed and dissolved in sulfuric acid. The small amount of hexavalent chromium carried down by the precipitate is then titrated, the solution is oxidized, and the total chromium present is titrated. The trivalent chromium content is calculated from the difference between the two titrations.

The Determination of Trivalent Chromium in Chromic Acid Plating Baths

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Introduction

All chromic acid plating baths contain some trivalent chromium produced by partial reduction of the chromic acid. In normal operation, the content of trivalent chromium (1–20 g/l) reaches an equilibrium with hexavalent chromium when the rate of reoxidation at the anode is equal to that of reduction at the cathode. The determination and control of the trivalent chromium are especially necessary when the anode area is smaller than the cathode area, in which case the equilibrium content of the trivalent chromium is higher. A precision of about 1 per cent of the trivalent chromium is fully adequate for control.

There are at present several methods of determining trivalent chromium in chromic acid plating baths. One method consists of titrating the hexavalent chromium, oxidizing the trivalent chromium to hexavalent chromium, titrating the total chromium, and computing the trivalent chromium by difference. This method is inaccurate because the difference is usually quite small compared to the quantities involved in the two titrations. Another method consists of precipitating the trivalent chromium two or more times as the hydroxide, washing it to remove the hexavalent chromium, oxidizing the chromic hydroxide, and titrating it. This method is slow and tedious, and it is difficult to obtain accurate results. A third method[1] consists of oxidizing the trivalent chromium with ceric sulfate and titrating the excess of ceric salt with sodium nitrite. This method is accurate and rapid, but it requires potentiometric titration equipment which is unavailable in many control laboratories.

II. Development Work

While working with solutions of chromic chloride, the author noticed that a green precipitate formed when such solutions were saturated with sodium fluoride, NaF. Further investigation showed that when a solution containing trivalent chromium and having a *p*H greater than 3 is saturated with sodium fluoride, the trivalent chromium is quantitatively precipitated as a double sodium chromic fluoride. The chromium content of the precipitate indicates that it is a compound of the type represented by $Na_3CrF_6 .xH_2O$ similar to compounds described by Mellor[2]. The precipitate can be easily filtered off and dissolved, and its chromium content can be determined by oxidation with ammonium persulfate and titration with ferrous ammonium sulfate. Hence a new method of determining trivalent chromium in chromium plating baths is suggested.

In tests to determine the accuracy of the method, the trivalent chromium was added as a solution of chromic chloride. This had been analyzed by evaporating it with sulfuric acid, oxidizing with persulfate, and titrating with ferrous ammonium sulfate. The hexavalent chromium was added either as sodium dichromate or as a solution of chromic anhydride (CrO_3 of the grade used by the plating industry). Sulfuric acid was added to the latter to make the weight ratio CrO_3:SO_4 equal to 100. To determine the effects of other possible constituents of a chromium plating bath, iron was added as ferric chloride, zinc as zinc sulfate, and copper as cupric sulfate. The 0.1-*N* ferrous ammonium sulfate was standardized

TABLE I. DETERMINATION OF TRIVALENT CHROMIUM IN CHROMIC CHLORIDE

Expt. No.	Cr^{III} Taken g	Cr^{III} Found g	Error	
			g	per cent
1	0.0349	0.0346	−0.0003	−0.9
2	0.0349	0.0348	−0.0001	−0.3
3	0.0349	0.0347	−0.0002	−0.6

against pure potassium dichromate in a 10 per cent sulfuric acid solution using ferrous ortho-phenanthroline as an indicator. The reagents were all of cp grade.

Measured samples of the chromic chloride solution were diluted to 50 ml, 4 g of sodium fluoride was added to each, the solutions were heated to boiling, and were then filtered through a fine sintered-glass filter and washed with cold water. The precipitate was dissolved in sulfuric acid and oxidized with ammonium persulfate plus silver nitrate. The hexavalent chromium was then titrated with ferrous ammonium sulfate. Table I summarizes the results of typical analyses.

When hexavalent chromium is present in the original sample some of it remains with the precipitate after it has been washed. This Cr^{VI} may be titrated before the sulfuric acid solution of the precipitate is oxidized. If, as in a plating bath, chromic acid is present, no precipitate is formed at the prevailing low *p*H. The *p*H must be raised at least to 3 or 4. If the solution is made alkaline, i. e., to a *p*H above 7, metal hydroxides form and make the filtration more difficult. In the following experiments about 75 per cent of the free chromic acid was neutralized with sodium hydroxide, giving a *p*H of about 5 to 6.

The results of experiments with hexavalent chromium present are summarized in Table II. In experiment 4, 10 g of $Na_2Cr_2O_7.2H_2O$ was dissolved in 50 ml of the solution of chromic chloride, and 4 g of sodium fluoride was added. The solution was heated to boiling and filtered while hot, and the precipitate was washed with cold water and dissolved in sulfuric acid. The occluded hexavalent chromium was titrated with ferrous ammonium sulfate. The solution was then oxidized with persulfate, and the total chromium was titrated as before.

In the other experiments, solutions containing known amounts of chromic acid and chromic chloride were prepared and their volumes were each adjusted so that after the necessary additions the volume would be about 50 ml. Four grams of sodium fluoride was added, and the sodium hydroxide solution was introduced dropwise while stirring to minimize the formation of hydroxides. The solution was heated to boiling, digested on the steam bath about 1 hour, filtered, and washed with a 2 per cent sodium fluoride

TABLE II. DETERMINATION OF TRIVALENT CHROMIUM IN THE PRESENCE OF CHROMIC ACID

Expt. No.	CrO_3 g	Chromium Found in Precipitate			Trivalent Chromium Taken g	Error	
		Hexavalent g	Total g	Trivalent g		g	per cent
4*	6.7	0.0005	0.0561	0.0556	0.0545	+0.0011	+2.2
5†	6.6	0.0002	0.0019	0.0017	0.0022	−0.0005	−23
6†	6.6	0.0003	0.0025	0.0022	0.0022	0	0
7	6.6	0.0005	0.0306	0.0301	0.0295	+0.0006	+2.3
8	6.6	0.0012	0.0586	0.0574	0.0567	+0.0007	+1.2
9	6.6	0.0006	0.0586	0.0580	0.0567	+0.0013	+2.3
10	6.6	0.0013	0.0594	0.0581	0.0567	+0.0014	+2.5
11	2.6	0.0004	0.0565	0.0561	0.0554	+0.0007	+1.3
12	2.6	0.0007	0.0570	0.0563	0.0554	+0.0009	+1.6
13	2.6	0.0005	0.0568	0.0563	0.0554	+0.0009	+1.6
14	2.6	0.0005	0.0566	0.0561	0.0554	+0.0007	+1.3
15	2.6	0.0004	0.0566	0.0562	0.0554	+0.0008	+1.4
16	0.5	0.0001	0.0277	0.0276	0.0274	+0.0002	+0.7
17	0.5	0.0001	0.0278	0.0277	0.0274	+0.0003	+1.1

*Cr^{VI} added as $Na_2Cr_2O_7.2H_2O$. †Determinations of Cr^{III} in the CrO_3 used.

TABLE III. EFFECT OF IMPURITIES ON DETERMINATION OF TRIVALENT CHROMIUM

Expt. No.	CrO_3 g	Added Impurity			Chromium Found in Precipitate			Trivalent Chromium Taken g	Error	
		Iron g	Zinc g	Copper g	Hexavalent g	Total g	Trivalent g		g	per cent
18	6.6	0.1	0.1	0.1	0.0108	0.0411	0.0303	0.0295	+0.0008	+2.7
19	6.6	0.1	0.1	0.1	0.0155	0.0458	0.0303	0.0295	+0.0008	+2.7
20	6.6	0.05	0.05	0.05	0.0255	0.0831	0.0576	0.0567	+0.0009	+1.6
21	6.6	0.1	0.1	0.1	0.0171	0.0741	0.0570	0.0567	+0.0003	+0.5
22	2.6	0.1	...	....	0.0008	0.0559	0.0551	0.0554	−0.0003	−0.5

solution. The hexavalent and total chromium in the precipitate were titrated as above.

In Table III are summarized the experiments in which salts of iron, zinc, and copper were added in concentrations that may exist in a chromium plating bath. In these experiments, the solutions were not digested on the steam bath and the precipitates were washed with cold water.

The trivalent chromium initially present in the stock solution of chromic acid was determined by the method of Willard and Young and was found to be 0.086 g/l. This is equivalent to 0.0022 g for the samples used in runs 5 and 6. The values given for the "trivalent chromium taken" have been corrected accordingly.

Abnormally low results were obtained in four unreported experiments. In these, digestion on the steam bath had been omitted and the precipitate was washed with cold water. This procedure, however, usually gave satisfactory results. Digestion of the precipitate and the use of a 2 per cent sodium fluoride wash solution minimizes loss of traces of the precipitate either through nonretention by the filter or by its solubility.

When iron, zinc, or copper are present, they are partially coprecipitated as hydroxides or double fluorides or both. The resulting larger precipitate occludes more hexavalent chromium. Thus more hexavalent chromium was found in the precipitates of experiments 18, 19, 20, and 21 than in the experiments reported in Table II. Experiment 20 which yielded the largest amount of occluded chromate had the bulkiest precipitate. In this experiment, the sodium hydroxide was added very rapidly, resulting in a bulky precipitate which filtered very slowly.

III. Recommended Procedure

The sample should contain about 0.05 g of trivalent chromium. This corresponds to a 10 ml sample of a bath containing about 5 g/l of Cr^{III}.

Dilute the bath sample in a 125-ml Erlenmeyer flask with enough water to give a volume of about 50 ml after the addition of the sodium hydroxide solution. Add 4 g of sodium fluoride. Add, dropwise while stirring, 7.5 ml of 5-*N* sodium hydroxide for each 10 ml of 2.5-*M* chromic acid anhydride in the bath sample. The resultant solution should have a *p*H of about 5 when tested on *p*H paper.

Heat the solution to boiling, digest it for one hour on the steam bath, and filter it while hot through a fine sintered-glass filter. Wash the precipitate two or three times with 2 per cent sodium fluoride solution. Transfer the bulk of the precipitate to a 750-ml Erlenmeyer flask containing about 100 ml of water. Dissolve the precipitate remaining in the filter by adding 1 or 2 ml of concentrated sulfuric acid, then, after a minute or two, add an equal volume of water and suck the hot acid solution through the filter. Transfer this filtrate to the 750-ml Erlenmeyer flask and add 20 ml of concentrated sulfuric acid. The precipitate will dissolve completely in the resulting hot solution. This procedure minimizes attack of the filter by the hydrofluoric acid which is formed and permits more rapid solution of the precipitate. Cool the solution and titrate the hexavalent chromium with ferrous ammonium sulfate using ferrous ortho-phenanthroline as an indicator.

Dilute the same solution after titration to 200 ml and oxidize by boiling it with 1.5 ml of 0.1-*N* silver nitrate, 5 drops of 1 per cent manganous sulfate, and ammonium persulfate. A 10 per cent solution of the latter is added in 5-ml portions until the solution becomes pink or orange. This usually takes about 100 ml. Continue boiling the solution for 10 minutes, add 2.5 ml of concentrated hydrochloric acid, and continue boiling until the pink color disappears. Cool the solution and titrate the total chromium with ferrous ammonium sulfate.

The trivalent chromium is calculated from the difference between the two titrations: g/l Cr^{III} = 1/7.34 × no. of ml difference × normality of ferrous ammonium sulfate solution ÷ no. of ml of sample.

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[2]J. W. Mellor, "A Comprehensive Treatise on Inorganic and Theoretical Chemistry", Vol. II (1922), pp. 138–139; Vol. XI (1931), pp. 363–364. Longmans, Green and Company, New York, N. Y.

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Abner Brenner

DR. ABNER BRENNER, Chemist and Assistant Chief of the Electrodeposition Section, National Bureau of Standards, was born in Kansas City, Mo., on August 5, 1908, and received his early schooling in that city.

Following studies at the University of Missouri, Columbia, Mo., from which he received his B.A. degree in 1929, and the University of Wisconsin, Madison, Wis., which granted him his M.S. degree in 1930, he entered government service with the National Bureau of Standards, Washington, D. C. Except for a period between 1933 and 1935 when he worked in the Bureau's branch laboratory in California, he has been connected with the Electrodeposition Section ever since. His continued studies, first at Johns Hopkins University, Baltimore, Md., 1931–1933, and later at the University of Maryland, College Park, Md., led to his Ph.D. degree from the latter institution, in 1939.

Dr. Brenner's many researches in electrodeposition cover a wide range of subjects: alloy deposition, cathode films, electroless plating, methods of measuring thickness of plated coatings, to mention only a few major divisions. He is now project director of Research Project No. 9 of the American Electroplaters' Society, which deals with physical properties of electrodeposited metals, a field to which he has also contributed in past years.

His published reports, found mainly in the Journal of Research of the National Bureau of Standards and in the publications of the American Electroplaters' Society, in many cases have become standard references.

The reader is struck by his inventiveness, particularly in the construction of measuring devices, his widely used Magna-Gage for thickness measurement and his Spiral Contractometer for stress measurement being conspicuous examples. His associates at the Bureau who see him at work speak with much respect of his persistence, bordering on obstinacy, when he has embarked on a difficult task.

From these characterizations one might expect to meet in Dr. Brenner the sheltered and introverted scientist, but nothing is further from the truth. On the contrary, his great store of humor which flavors the presentation of his papers makes him a popular speaker, and he has been an effective leader of the Baltimore-Washington Branch of the American Electroplaters' Society, which he has served in several capacities, including that of president.

Several honors have come to Dr. Brenner. They include membership in the honorary societies Phi Beta Kappa and Sigma Xi; two Proctor Awards of the American Electroplaters' Society, with G. Riddell in 1946 and with S. Senderoff in 1948; and the Award for Meritorious Service of the U. S. Department of Commerce, in 1948.

Dr. Brenner lives with his family in Chevy Chase, Md., just outside the District of Columbia border. A goodly part of his leisure time is spent with his four boys, age 5–13; what remains, at his piano lessons, to the annoyance of neighbors, he says. His sports activities are confined to swimming in a local swimming pool and in the ocean or New Hampshire lakes during vacations.

project no. 5

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Acknowledgment is due the Research Committee, Mr. W. M. Tucker, Eastman Kodak Company, Chairman; the Research Directing Sub-Committee, Mr. B. C. Case, Hanson-Van Winkle-Munning Company, and Mr. G. M. Cole, Ternstedt Division, General Motors Corporation, Chairman and Vice-Chairman, respectively; and the Project Committee, Mr. G. M. Cole, Chairman; Mr. L. B. Sperry, Doehler-Jarvis Corporation; and Mr. Leslie Borchert, Houdaille-Hershey Corporation, for their contributions to this project.

*AUTHORS

NOVEMBER, 1950

Effect of Impurities and Purification of Electroplating Solutions

I. NICKEL SOLUTIONS

4. THE EFFECTS AND REMOVAL OF COPPER

The effects of copper as an impurity in nickel plating solutions have been investigated, and data are presented which show the resulting change in certain physical properties of the electrodeposited nickel.

Concentrations of copper in the nickel solution ranged from 5 to 400 mg/l, or 5 to 400 ppm.

Four types of nickel solution have been studied—two of the Watts type at *p*H 2.2 and 5.2, one of an alloy type containing a small amount of cobalt, and one with organic compounds added as brighteners. These solutions were selected as being representative of present-day practice.

Six physical properties of the electrodeposited nickel were studied, namely: appearance, adhesion, ductility, hardness, throwing power and efficiency, and salt-spray-corrosion resistance. A bath free from copper having been selected as standard, the changes in physical properties were evaluated as concentrations of the impurity were increased. For the most part, results have been reported as percentage change rather than in absolute units. This method of reporting has a definite advantage, in that the operator can judge with less confusion what changes will take place in his particular solution. Hence, graphs and tables are limited to changes and trends for each of four general types of solution.

The rate of removal of copper from nickel plating solutions has also been studied, and the results were found to favor the low-current-density electrolytic procedure.

Experimental

A. *Preparation of Panels and Evaluation of Physical Properties*

The methods of preparation and purification of solutions, preparation and production of panels, and subsequent testing of the nickel deposits were those described in a previous publication (Plating **36**, 1137–1145 (1949)). As the evaluation of the effects of contamination, excepting hardness, were mainly visual and involved the personal element, reference panels were prepared which served to standardize such unstandardized terms as "milky", "bright luster", etc., used to describe appearance.

In the organic solution it was found that a wetting agent and frequent filtration were necessary to eliminate pitting. Panels were produced from this solution both with and without addition of wetting agent, and there was no noticeable difference in the effect of copper on the deposits. Additions of the second brightener, triaminotolyldiphenylmethane, were

TABLE I. EFFECT OF COPPER ON THE APPEARANCE OF NICKEL DEPOSITS

Copper Concentration mg/l*	Bath Type			
	Watts† *p*H 2.2	Watts† *p*H 5.2	Nickel-cobalt *p*H 3.75	Organic *p*H 3.2
0	2	2	mirror bright	bright luster
10	2	2	milky in low current density areas	milky in low current density areas
25	2	2	uniformly milky	uniformly milky
50	2 (R)	2–3 (R)	uniformly milky (R)	uniformly milky (R)
75	2 (R)	2–3 (R)	dull luster (R)	dull luster (R)
100	2 (R)	2–3 (R)	dull luster (R)	dull luster (R)

*1 mg/l = 1 ppm = 0.00013 oz/gal. †Step of Eastman Grey Scale.
(R) Roughness.

made at intervals to maintain its correct concentration in the solution.

B. *Effects on Physical Properties*

1. *Appearance.*—Two tests were used to measure the effects of copper on appearance. First, the grey nickel deposits were compared to the Eastman Grey Scale and assigned step values. Second, the bright nickel deposits were classified in a range from mirror bright to a dull matte. Table I summarizes the effect of copper on appearance of the nickel deposits from the four solutions at the standard average current density of 40 asf.

It has been generally known that small amounts of copper in nickel plating solutions affect the appearance, or brightness, of the deposits primarily in recessed areas and low-current-density regions. This observation has been the criterion for the removal of copper, as it happens to be most easily recognized and is a cause for rejections. The cathode current density can change the numerical limits of copper contamination at which appearance may be affected.

In general, brightness of deposits is affected when the copper concentration reaches 10 ppm in the solution, the effects being noticed in areas which receive from six to eight amperes per square foot. At 50 ppm deposits at practically all current densities are adversely affected. The deposits from all four baths are ultimately affected by increase in copper concentration. For the Watts-type deposit the change in color is somewhat later than for the bright deposits. Roughness, starting at the edges, became noticeable on all deposits when the copper concentration areas reached 50 ppm and extended to other areas as the copper was increased to 100 ppm.

2. *Adhesion.*—Adhesion of the nickel coating to the steel base showed no discernible change in any type deposit at any current-density area with copper concentration up to 100 ppm. The method used to measure the adhesion, bending of the plated steel panel, is admittedly rough but was the one most suitable for this work and approximates most satisfactory methods used in the industry at this time.

3. *Ductility.*—Discernible changes in the ductility of the nickel deposits appeared with a copper content of the solution of from 10 to 25 ppm. As the copper content increased, the ductility of the deposits decreased. No units for reporting this test are available, and it is not possible to state at what copper content a deposit is useless because permissible limits vary with the end use.

4. *Hardness.*—Because the results of common hardness tests are considered doubtful of interpretation in some quarters and because none is likely to try to judge the copper content of a deposit from its hardness, nor use copper as a hardener for nickel deposits, the results are given in terms of percentage change from the pure deposit produced by the addition of copper to the plating bath. The data are presented in Table II, in which a plus figure represents gain, a minus figure loss of hardness.

The deposits from the low-*p*H Watts bath showed a definite increase in hardness on addition of copper, reaching a maximum at about 75 ppm copper. The effect of copper addition on the hardness of deposits from the other three baths is less marked, and the data for these deposits may not be significant. Possibly a maximum hardness is reached also in deposits from these baths.

It should be stated that it is common experience to find poor reproducibility of results in hardness testing of electrodeposits. As indicated by the figures, more hardness readings would have been required if exact determination of the hardness of the nickel deposits and its trends had been desired.

5. *Salt Spray (Fog) Corrosion Resistance.*—The use of outdoor exposure tests for evaluation of corrosion resistance was considered too time consuming and costly for this project, five or more test locations and frequent inspections being considered necessary for worthwhile results. For this reason, the salt-spray (fog) test was employed.

The tests were made according to A. S. T. M. designation B117-49T, and the system of rating was that described in PLATING 36, 1137–1145 (1949)*. The test panels were steel, nickel plated, unbuffed, and not chromium plated.

The effect of copper was determined on three thicknesses of nickel deposits from each of the four baths—0.0003, 0.001, and 0.0015 inch. The as-plated deposits be-

TABLE II. EFFECT OF COPPER ON THE HARDNESS OF NICKEL DEPOSITS*

Copper Concentration mg/l	Bath Type			
	Watts 2.2 *p*H	Watts 5.2 *p*H	Ni-Co 3.75 *p*H	Organic 3.2 *p*H
	percentage change			
0	0	0	0	0
10	+ 2	+27	−15	+19
25	+17	+22	−22	+12
50	+77	+13	+13	+18
75	+86	+10	+12	+20
100	+15	+14	−19	+ 7

*Tests made by A. E. S. Research Project No. 9 at the National Bureau of Standards, Washington, D. C.

*This is the system employed by A. S. T. M. Committee B-8 in its outdoor exposure tests, but contrary to the implication of the aforesaid reference, it is not a finally standardized system.

haved in the test in a surprisingly consistent manner, excepting one or two of the 0.0015-inch deposits. The results were converted into percentages using the hours for standard breakdown of deposits from corresponding pure bath as 100 per cent performance.

The percentage reduction in salt spray (fog) resistance due to a given copper contamination was, within experimental errors, the same for 0.001 and 0.0015-inch thick deposits and for all four solutions. Hence, for all practical purposes, the results for all deposits of these thicknesses can be combined in one curve, as shown in Fig. 1. The 0.0003-inch deposits failed in less than one hour, but they revealed substantially the same trend as the thicker deposits.

The curve in Fig. 1 shows that for unbuffed nickel on steel surprisingly small amounts of copper produce important deleterious effects on the salt-spray resistance. With 40 ppm (0.0052 oz/gal) of copper in the baths, the deposits from all baths suffered a loss of approximately 50 per cent of their normal resistance to salt-spray exposure.

The heavier (0.0015-inch) deposits were consistently better than the thinner (0.001-inch) deposits at identical copper concentrations. However, the thinner plates from baths with zero copper concentration had higher salt-spray resistance than the thicker plates from baths containing some of the higher concentrations of copper.

6. *Throwing Power.*—Since no gassing was observed during the preparation of test panels in nickel solutions containing copper as an impurity in the range of 10–100 ppm, it was assumed that the cathode efficiency was unchanged. Thus any change in deposit thickness, as compared to the thickness of the pure deposit as a standard, was considered to be due to a change in the throwing power of the solution. Table III summarizes the results. It can be seen that the effect, if any, is insignificant.

TABLE III. EFFECT OF COPPER ON THE THROWING POWER OF NICKEL PLATING SOLUTIONS

Copper Concentration mg/l	Bath Type			
	Watts *p*H 2.2	Watts *p*H 5.2	Nickel-cobalt *p*H 3.75	Organic *p*H 3.2
	percentage change			
0	0	0	6	0
10	+2	−3	+7	+1
25	−1	−5	+8	+1
50	+7	−6	+7	+1
75	−2	−5	+2	+4
100	−2	−11	+1	+3

C. *Removal of Copper*

1. *Procedures.*—Two methods for the removal of copper from nickel solutions were studied, namely, low-current-density electrolysis and high-*p*H treatment with nickel carbonate.

The procedure for preparation and plating of the panels and the apparatus was that described in a previous publication (PLATING 36, 1137–1145 (1949)). The current densities employed were 1, 2, 3, and 4 asf at the operating temperatures of the nickel baths. The agitation rate was 4 ppm of solution past the cathode. Flat pieces of steel, 2 inches wide by 3½ inches long, were used as cathodes, and the amounts of nickel and copper deposited were determined by weighing. All copper lost from a bath was assumed to have been codeposited with the nickel on the cathode.

Initial studies ndicated that in all cases the copper was rapidly lowered from 100 to 25 ppm, but for lower concentrations the best operating conditions must be more carefully determined. Removal studies were, therefore, started at a copper concentration of 25 ppm.

For the high-*p*H removal of copper, nickel carbonate was added to a series of nickel solutions containing 100 ppm of copper. The amounts added were such as were necessary to give a series of *p*H values ranging from 2.2 to 6.0. Care was taken that *p*H measurements were made under equilibrium conditions. The time for attaining equilibrium was a function of rate of agitation and temperature.

2. *Evaluation of Results.*—In all cases studied of electrolytic removal of copper, a current density of 2 asf was the most effective in giving the highest removal rate. If time is not a factor, a current density of 1 asf can be utilized to remove the copper more economically from the standpoint of loss of deposited nickel, at least up to 8000 ampere-minutes per gallon. The ratio of nickel to copper de-

(*Continued on page 1160*)

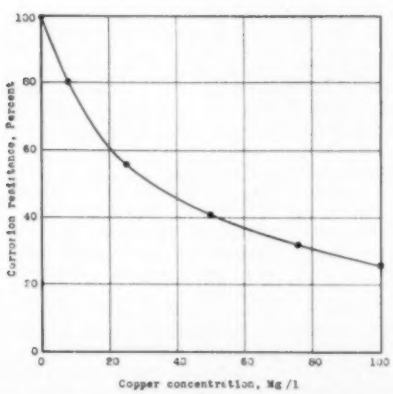

Fig. 1. Effect of copper concentration in nickel plating solutions on salt spray (fog) resistance of nickel deposits

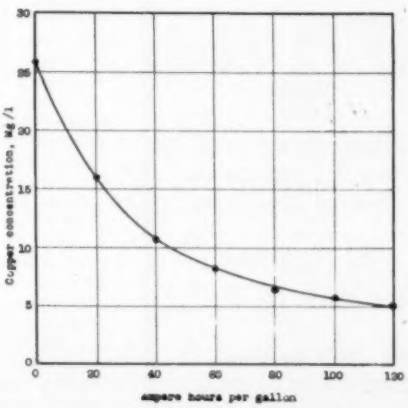

Fig. 2. Electrolytic removal of copper from nickel plating solutions at the optimum current density of 2 amperes per square foot

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Porosity

(*Continued from page 1159*)

posited at 2 asf is about double the ratio at 1 asf. With an increase in current density from 2 to 3 asf, the ratio of nickel to copper in the deposit increases about fifteen times.

Fig. 2 shows the limits and the optimum rates at which copper is removed electrolytically, at the specified conditions, from the nickel plating baths studied.

with an appreciable loss of nickel. In the case of the nickel-cobalt bath, raising the *p*H to 5.85 reduced the copper concentration from 92 to 31 ppm. The organic-type bath was treated to a *p*H of 5.95, and the copper content reduced from 92 to 15 ppm.

Nickel is also lost in this treatment, as in the electrolytic method. In no case was the copper content reduced through high-*p*H treatment to as low values as obtained by electrolysis at low current density.

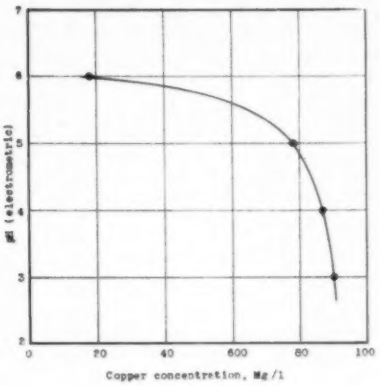

Fig. 3. Removal of copper from nickel plating solutions by high-pH precipitation

Since the optimum current density for the removal of copper from the solution is shown to be 2 asf, it becomes apparent that to increase the rate of removal of copper from a nickel plating bath one must increase the cathode area but not the current density.

The rate of electrolytic removal of copper showed an increase when the temperature of the nickel plating bath or the rate of agitation was increased.

Case has investigated very thoroughly the rate of electrolytic removal of copper from a bright nickel-cobalt solution (Proc. Am. Electroplaters' Soc. **34**, 228–248, (1947)). Under operating conditions, Case studied the effect of varying the rate of agitation, current density, *p*H, and temperature of the solution. He found that at 160° F and *p*H 3.7 the rate of removal of copper when present in an amount of 20 ppm was increased about 75 per cent when agitation was increased from 4 to 8 feet per minute. With conventional air agitation, the rate would be increased still further. It should be noted that Case used vertically corrugated cathodes with a projected current density of 5 asf.

To determine the effectiveness of removing copper by raising the *p*H, a Watts-type grey-nickel bath at a *p*H of 2.5 and containing 87 ppm of copper was treated with nickel carbonate. When the *p*H had reached 6.0, the solution was filtered and analyzed for copper content. The treatment removed all but 13 ppm of copper

Conclusions

The results of this investigation of the effects and removal of copper from nickel solutions can be summarized as follows:

Ten parts per million of copper cause a loss of luster in the common alloy- and organic-types of bright nickel deposit, a loss of ductility, a 20 per cent loss of salt spray (fog) resistance, and a loss of throwing power in Watts-type nickel solutions.

At 25 parts per million there are a further loss of luster in bright-nickel deposits, a further loss of ductility, a 50 per cent loss of salt spray (fog) corrosion resistance.

At 50 parts per million, there are a substantial loss of luster in bright-nickel deposits and a darkening of the high-*p*H Watts deposit, a further loss of ductility in all deposits, a significant increase of hardness of the low-*p*H Watts deposit, a 60 per cent loss of resistance to salt water fog.

At 100 parts per million, the deposits become unusuable for all practical purposes.

Copper can be removed electrolytically, at optimum current densities of 1–2 amperes per square foot. This method permits reductions to the lowest concentrations. More vigorous agitation of the solution increases the amount of copper removed.

Copper can also be reduced by a high-*p*H treatment with nickel carbonate to a minimum value of 15 parts per million but at a loss of nickel from the solution.

Mirror-Bright

(*Continued from page 1152*)

Both bright and semibright deposits were fine grained, and more so than a molasses, acid sulfate copper plate (Fig. 4). Their grain growth during heat treatment (1650° F, 15 minutes) is more rapid than the growth of molasses, acid sulfate copper plate, indicative of higher stress, to which no harmful effect on ductility can be attributed. Quantitative data on stress were not obtained.

A very interesting property of the bright and semibright plates was found after heating to 1650° F. Wheel coloring was just as easy as in the as-plated condition before heating. On the other hand, after being heated to 1650° F, usual acid copper plate was extremely difficult to buff and color. In the as-plated condition, the semibright plate is much easier to color buff than other copper plates. There is relatively little tendency to "drag".

The bright copper showed good scratch-hiding power. For example, bumper-bar sections polished through 180-greased emery wheels and plated with 0.001-inch bright copper plus 0.0015-inch bright nickel had a better color and scratch appearance than those plated with 0.0025 inch of bright nickel alone*. Thicker copper plates (0.002–0.003 inch) followed by 0.001-inch bright nickel produced an excellent appearance and were essentially equivalent to bright nickel over buffed copper. Very good results were also obtained on die castings with only 0.001-inch total plate divided equally between bright copper and bright nickel.

Applications

Because of its good scratch-hiding power and ductility, bright copper, as described herein, was a good undercoat for bright nickel on steel and diecast parts. It may also be used as a decorative plate for both metals and plastics. Due to its "glasslike" smoothness, it may be especially useful as a lubricant during cold forming. Its rate of oxidation during heating is lower than rates for mat or other fine-grained plates. Hence, it can also be used advantageously during hot forming. Additional important uses of this kind of bright copper plate will doubtlessly be found during its commercial development.

Acknowledgments

The authors acknowledge with appreciation the permission of the Houdaille-Hershey Corporation (for which the research and development work was conducted) and of Battelle Memorial Institute (where the work was carried out) to publish this paper. The assistance of John G. Beach and Frank Schladen in carrying out some of the tests is acknowledged.

*Thicknesses given are average thicknesses, based on total area of the parts. Minimum values were probably about 60 per cent of the average thicknesses.

Book Review

DR. HAROLD J. READ
Associate Professor of Metallurgy, Pennsylvania State College

Repertoire Technique Des Applications Industrielles Du Chrome Dur by Paul Morisset, 1948. viii + 219 pages. Gauthier-Villars, 55 Quai des Grands-Augustins, Paris, France. Price, 600 francs.

This volume (in French) is probably the most complete resume of the industrial applications of hard chromium plating that is now available. It is not primarily a book on *how* to do hard chromium plating: it emphasizes instead *what* can be done with the process. There are some passages relating to plating technique, but they are comparatively brief. Reasons are given as to why hard chromium is advantageous in each application, and often data are given to prove the point. Supplementary operations, such as grinding or heat treating, are given proper attention. The book is composed of four main sections, each of which will be reviewed briefly.

The first section deals with the physical, chemical and mechanical properties of hard chromium and presents succinctly the various steps of the plating and finishing operations.

A catalogue of the uses of hard chromium comprises the second section, which is divided into 10 major categories according to industries—automotive, aviation, chemical, etc. Each entry is followed by code numbers and letters which indicate the status of the application with respect to proven usefulness and whether or not it is applicable to new or used workpieces.

The third section is by far the most interesting part of the book, because it is here that nine generalized examples which are illustrative of a wide variety of applications are discussed in some detail. In each case the following topics are considered: the properties of chromium which justify its use, details of plating technique peculiar to the example, details relating to the use of the plated object, and a comparison of results obtained with plated and unplated pieces. In some instances there is also a discussion of cost relationships.

A bibliography of 1119 entries (some of which are merely cross-references) arranged alphabetically according to authors constitutes the final section and occupies somewhat more than half the total number of pages. The citations from the literature of many countries cover the entire field of chromium plating, and there is no indication as to which of them relate primarily to hard chromium. In some cases, perhaps a quarter of the entries, brief abstracts are appended to the citations.

It is unfortunate that there is no index and that the numerous photographs are not accompanied by descriptive material which would explain why they are included in the text.

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readers' questions of general interest

Q. 102. What is a good routine for plating 1.2 mil of copper on stainless-steel pans? We have trouble with lack of adhesion.

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Numerous activation methods are described in the literature. Among cathodic treatments used successfully is the treatment in 5–50 per cent sulfuric acid at room temperature. In U. S. Patent 2,363,973, November 28, 1944 to J. M. Kennedy *et al.*, assignors to Revere Copper and Brass, Inc., the surface after having been cathodically treated in sulfuric acid is first given a strike coating in a dilute copper sulfate-sulfuric acid bath and then copper plated in a more concentrated copper sulfate-sulfuric acid bath. In a modification of the method, the article is made the cathode, the anode, and again the cathode in dilute sulfuric acid, best results having been obtained in a 30 per cent (by weight) sulfuric acid solution to which may be added 10 per cent (by weight) of anhydrous sodium sulfate.

Another method makes use of simultaneous activation and plating in a nickel chloride (32 oz/gal), hydrochloric acid (11–16 oz/gal) strike at room temperature for ½–3 minutes at 75 asf. The anodes are electrolytic nickel. After the thin nickel film has been deposited, the articles can be transferred to any common plating solution for build-up of the desired deposit.—M. B. Diggin.

Q. 103. What lead concentration should be used to brighten the deposit from a rochelle salt copper bath containing 2.5 oz/gal copper, 0.75 oz/gal free sodium cyanide, 4 oz/gal sodium carbonate (anhydrous), and 6 oz/gal rochelle salt?

A. Phillips and Meyer have reported the use of 0.01 g/l lead, added as sodium plumbite. Private file data indicate that 0.02–0.03 might be optimum at a bath *p*H of 12.8 colorimetric, a temperature of 180° F, a cathode current density of about 40 asf, and a high degree of agitation.

There are a number of bright-copper cyanide processes that are superior to the use of a lead-containing rochelle salt copper bath.—A. K. Graham.

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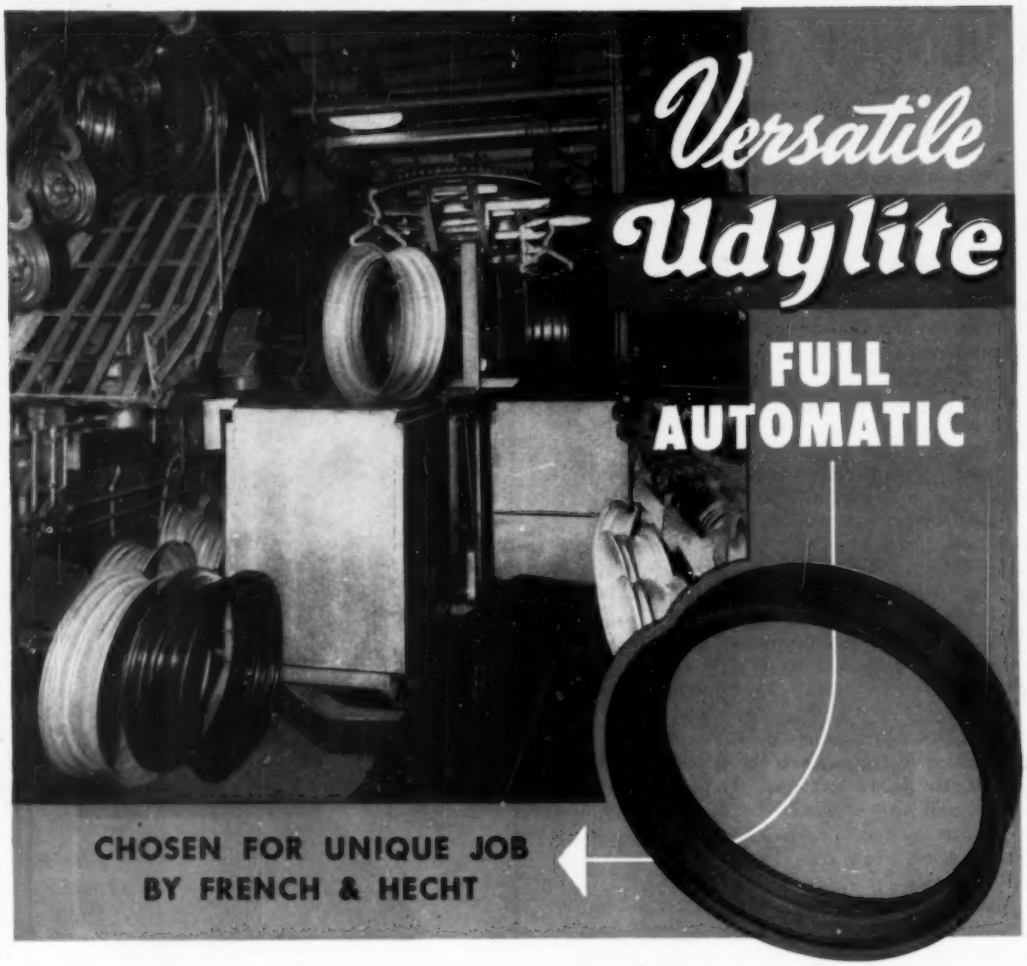

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Flame-Sprayed Polythene Coatings Provide Exceptional Corrosion Resistance. Materials & Methods **30,** 81 (September, 1949).
Exposure tests of one year's duration have shown no deterioration by hydrochloric, hydrofluoric, sulfuric, or formic acid. Polythene films, modified with graphite, were found to be free of porosity by spark tests in the neighborhood of 30,000 volts, and various other short-time exposures to a variety of chemicals have been successfully withstood.

Investigations Into Cyclone Dust Collectors. A. J. ter Linden. Inst. Mech. Eng., Proc. **160,** 233–240; discussion, 240–251 (September, 1949).
Describes an investigation to determine the most efficient shape of a cyclone by measuring the effect of variation of each of its principal dimensions on the efficiency; as a result, a very efficient cyclone shape was developed. Efficiencies are given for different sizes of similar shape and for various sizes of dust particles. Includes diagrams and photographs.

Electrolytic Iron. Ch. Tschappat. Schweiz. Arch. angew. Wiss. u. Tech. **15,** 225–242 (August, 1949).
Describes principles of direct electrolytic manufacture of 0.05–0.3 mm sheets, eliminating melting and rolling operations. This material is especially valuable in manufacture of electrical machinery. The commercial method is thoroughly described. Electrical, chemical, and mechanical properties are tabulated and charted. 26 ref.

Metal Plating from Carbonyl Gases. Anon. Chem. Eng. **50,** 118–119 (October, 1949).
Gives details of above process and experimental work on it being done by Commonwealth Engineering Com-

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pany, Dayton, Ohio. Compared with electroplating, gas plating is said to be faster, to give better reproduction of irregular surfaces, and to be applicable to nonconductors, such as wood and glass.

Heatless Degreasing in 10 Seconds by Ultrasonic Waves. Anon. Factory Management and Maintenance **107**, 130 (November, 1949).
Shows how an ordinary caustic cleaning solution can remove either heavy or light grease from steel parts in 10 seconds by use of ultrasonic vibrations.

Chromizing Process as Developed and Used by Diffusion Alloys, Limited of London. Charles A. Naugle. Tech. Data Digest **14**, 13–19 (November, 1949).
Inasmuch as numerous attempts to develop a comcially feasible chromizing process, both in the United States and Europe, have met with failures, and since it is felt that such a process might serve as an aid in conserving strategic alloying metals, the above diffusion process was evaluated by an engineer from the U. S. Army's Air Material Command. Includes details of procedure, equipment, and results. The latter are illustrated by macro- and micrographs. Concludes that the process is commercially feasible and superior to the German process. Briefly describes two other diffusion processes developed by the same company: "Sichromel" for simultaneous diffusion of silicon, chromium, and aluminum into steel surfaces; and the "Hypoeutectoid" controlled-carburizing process.

Evaluation of Paint Films: The Interchemical Adherometer. Clifford J. Rolle and Theresa L. Dietrich. Anal. Chem. **21**, 996–997 (August, 1949).
Describes method and apparatus for resolving stripping-force measurements of organic coatings on metal surfaces into their basic factors of plasticity and adhesion.

The Electronic Offset Plate. Adam Henri Reiser. Printing Equipment Engineer **78**, 59 (August, 1949).
Describes preparation of plate. On its completion metal is deposited around the image by electrolytic means, sinking the image and making an intaglio or deep-etch plate. Discusses its life expectancy.

Factors in Judging Selenium Rectifiers. I. R. Smith. Westinghouse Engineer **9**, 136–139 (September, 1949).
Discusses change of characteristics with time on the shelf and in operations. Describes testing methods.

Fatigue Characteristics of Electroformed Sheets with and without Iron Backing. Harry K. Herschman and Carroll Thomas. Natl. Bur. Stds. Research Paper RP2030. (January, 1950). 10 pp.
Flexural fatigue properties have been determined for electroformed iron-nickel sheets bonded with either solder or a plastic adhesive to open-hearth iron. Results show that the fatigue limit of the iron-nickel

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composite was decreased when a thin deposit of chromium was applied to the nickel face. Heating the iron-nickel-chromium sheets at 260° C (500° F) before machining, however, improved their fatigue properties. The fatigue limit of the plates bonded with the plastic adhesive were significantly higher than those joined by solder.

Increasing the Corrosion Resistance of Phosphate Films by Subsequent Treatment with Pore-Filling Materials. W. Machu. Arch. Metallkunde **3,** 335–340 (October, 1949).
Filling the pores of phosphate films on aluminum and aluminum alloys with insoluble inorganic compounds reduces the porosity of such films by about 50 per cent. Whereas the addition of inhibitors increases rather than decreases porosity, their use is recommended because they improve corrosion resistance. Effects of different inorganic compounds were comparatively evaluated. Includes tabulated data.

Experiments in Chromium Electrodeposition with Radioactive Chromium. Fielding Ogburn and Abner Brenner. J. Electrochem. Soc. **96,** 347–352 (December, 1949).
Any used chromic acid electroplating bath contains some trivalent chromium. Whether the metal is deposited from this bath directly from the hexavalent state or through the trivalent state has never been conclusively demonstrated. Tagging the chromium with a radioactive isotope indicates that it is deposited directly from the hexavalent and not from the trivalent state.

The Commercial Production and Use of Precious-Metal Electrodeposits. R. Weimer. Metall **3,** 376–381 (November, 1949).
Surveys and discusses methods of production, applications, and limitations of gold, silver and platinum electroplated tools and articles.

Electrodeposition of Chromium-Tungsten Alloy Plates. Donald G. Rogers and Arthur A. Burr. J. Electrochemical Soc. **97,** 67–69 (February, 1950).
From a solution of 200 g/l chromic acid, reduced to a trivalent chromium content of 40 per cent with 300 g/l of ammonium citrate and containing 150 g/l of tungstic anhydride, alloy plates of chromium and tungsten of thicknesses up to nearly 0.0001 inch were deposited at a temperature of 60–75° C. The plates have excellent appearance and resistance to corrosion by any of the common inorganic acids.

Electroformed Masks for Production Painting. Val Jones. Production Eng. Managem. **25,** 43–45 (February, 1950).
Describes and illustrates making and use of the above for painting intricate designs on embossed surfaces at high production rates. Application to the Oldsmobile hubcap is detailed.

Steel Shot Speeds Blast Cleaning; Shot Peening. L. J. Wieschhaus. Iron Age **165**, 82–85 (February 2, 1950).
Describes newly developed cast-steel shot which causes less wear on equipment, lasts longer, and eliminates some pickling. Advantages are said to offset cost premium over chilled-iron shot. Tru-Steel Shot, manufactured by Steel Shot Producers, Inc., Butler, Pa., is produced directly from molten steel by a triplexing operation which controls chemical analysis and temperature of the molten metal and produces shot that is round and tough. Photographs show comparative resistance to fracture based on service tests.

From a Metallurgist's Notebook: Cadmium Plating Defects. H. H. Symonds. Metal Ind. (London) **76**, 43–44 (January 20, 1950).
Determination of the origin of certain spots on cadmium plated steel shutters involved investigation of the trichlorethylene used for initial degreasing, the the petroleum jelly for lubrication of moving parts, the paper envelopes in which the shutters were normally sealed, and other factors, before the conclusion was reached that spotting was caused by accidental application of a corrosive liquid carried in finely divided form in the atmosphere.

Electroplated Tin-Zinc Alloy Coatings on Iron and Steel Components. E. E. Halls. Metallurgia **41**, 68–73 (December, 1949).
Details are given of the plating process together with results of comparative corrosion tests. Usual compositions are 50–50 and 80–20 tin-zinc.

Electrocrystallization of Metals. V. V. Gikhailov. Uspechi Khimii **18**, 724–736 (November-December, 1949).
Reviews formation and growth of crystals during electrolysis. Influence of different factors, such as concentration of solution and current density, on rate of nucleation and rate of crystal growth was thoroughly investigated. Data are tabulated and charted. 53 ref.

Surface Treatment and Finishing of Light Metals. V. S. Wernick and R. Pinner. Sheet Metal Inds. **27**, 71–81 (January, 1950).
Deals with chemical conversion coatings for aluminum and its alloys, history of chemical oxide coatings, theory of chemical oxidation, and the proprietary processes known as "M. B. V." and "E. W." Includes tables and graphs showing effects of various factors. 26 ref. (To be continued.)

The Rate of Diffusion of Oxygen through Silver on Silver-Plated Copper Wires. Karl Hauffe. Z. anorg. Chem. **257**, 279–288 (December, 1948).
Above was studied at 700 and 610° C and an oxygen pressure of 1 atm. Results are compared with those obtained by other investigators. Data are graphed and tabulated. 15 ref.

Electrolytic Polishing of Metal Surfaces and Its Importance in Microhardness Testing. K. Longard. Arch. Metallkunde **3**, 381–386 (November, 1949).
Shows that the work-hardening effect of mechanical polishing makes it impossible to obtain accurate microhardness data. This difficulty is absent in electropolished specimens. Numerous tests were made to determine the most favorable polishing conditions. Graphs and photomicrographs show comparative results. Electropolishing methods for different metals are tabulated.

Studies on the Structure of Hard Chromium Plate. Cloyd A. Snavely and Charles L. Faust. J. Electrochem. Soc. **97**, 99–108 (March, 1950).
Structural changes which take place during annealing of chromium plate are illustrated by a series of photomicrographs. Shows that recrystallization can be effected between 300 and 500° C. Loss of hardness is concurrent with recrystallization. Results of hydrogen-extraction tests are given up to 650° C. X-ray and electron-diffraction studies show that heating to above the temperature range at which the plate softens does not destroy the normal preferred orientation.

Chromium Removal by Ion Exchange and Comments on the Chemistry of Chromium Complexes. Don E. Bloodgood and Aubrey Strickland. Water & Sewage Works **97**, 28–32 (January, 1950).
Describes attempt to develop a method for removing chromium from plating wastes, both for detoxifying the wastes and for recovering the chromium, by utilizing ion-exchange resins. The resins are effective in removing the chromium from solution, but no satisfactory methods have been developed for regenerating them. 10 ref.

Caustic Soda versus Construction Materials. Chem. Eng. **57**, 213–214, 216 (January, 1950).
Part II of a symposium in which a representative group of construction materials are evaluated for services involving caustic soda. Includes the following brief articles: "Rubber Linings," E. L. Lockman; "High-Silicon Iron," Walter A. Luce; "Stainless Steel," W. G. Renshaw; and "Cements," Raymond B. Seymour. Not recommended are chemical stoneware (F. E. Herstein); aluminum (Ellis D. Vernik, Jr.); and tantalum (Allan L. Percy).

Caustic Soda versus Construction Materials. Chem. Eng. **57**, 215–216, 218, 220, 222 (February, 1950).
Part III of a symposium in which a representative group of construction materials are evaluated for services involving caustic soda. Consists of the following: "Carbon and Graphite," R. O. Joslyn; "Silicones," W. J. Hargreaves and Frances Henson; "Iron and Steel," Albert W. Spitz; "Protective Coatings," Kenneth Tator; "Nickel, Nickel Alloys," W. Z. Friend; and "Durimet," Walter A. Luce.

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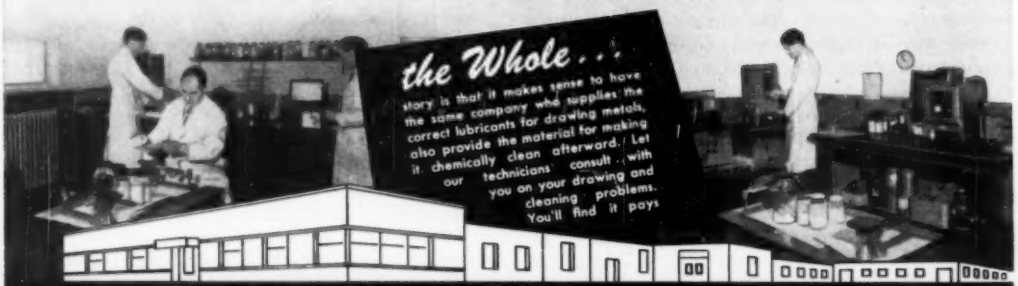
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No. 2,516,105, July 25, 1950—Electrolytic Polishing of Metals—E. Der Mateosian.

I have discovered a composition for an electrolyte which permits the control of the above named effects (polarization and capacity for carrying a heavy current) and includes simply a solution of a substantially neutral salt, such as an alkali metal salt of a mineral acid in water and an organic solvent such as alcohol. The concentration and *p*H of the solution are determined by the polishing problem on hand. The *p*H of the solution is adjusted until polishing takes place at the anode, which value of *p*H I call the "polishing *p*H" of the solution.

EXAMPLE I. To 10 milliliters of a saturated aqueous sodium nitrate solution there was added 100 milliliters of ethyl alcohol. The solution containing the sodium nitrate and the alcohol was cooled to about 10° C (50° F) and used to polish a specimen of relatively pure iron after the adjustment to polishing *p*H of a value slightly more than 7 by the addition thereto of a few drops of 1.0-normal sodium hydroxide solution . . . The anode was chilled to a temperature of about minus 30° C (−22° F) and subjected to electrolysis at a current density of 0.3 amperes per square centimeter (280 asf). Examples of the metals electropolished were: pearlitic steel, "Armco" iron, austenitic steel, 0.45 carbon steel, 18-8 stainless steel, nickel, 70-30 brass, and aluminum.

CLAIM 2. The method of electrolytically polishing metals of the group consisting of ferrous metals, nickel, brass and aluminum comprising making a specimen of the metal to be polished an anode in an electrolytic cell in which the electrolyte consists essentially of a mixture of a concentrated aqueous solution of an alkali metal salt of an acid selected from the group consisting of nitric, sulfuric, chromic, hydrochloric, hydrobromic, hydroiodic and hydrofluoric acids and a completely miscible liquid selected from the group consisting of methyl alcohol, ethyl alcohol, glycerine, ethylene glycol, acetone and isopropyl alcohol, adjusting the *p*H of the mixture to between 6 and 8, chilling the anode to a temperature of at least 10° C (50° F) below that of the electrolyte, and passing an electric current through said cell.

7 claims, 9 examples, 2 figures.

References cited: U. S. Patents 1,787,672; 2,153,952; 2,154,468; 2,313,425; 2,375,394; 2,378,002; 2,387,313; 2,428,141. British Patent 550,176. Proc. Am. Electroplaters' Soc. **33,** 60, 64 (1946).

No. 2,517,441, August 1, 1950—Electrodeposition of Chromium—Russell Raab, assignor to Ductile Chrome Process Company, Detroit, Mich.

It is . . . the primary object of my invention to provide an improved electrolyte for chromium plating which is characterized by high throwing power, high plating efficiency and inherent stability when compared to conventional electrolytes . . . to provide . . . a plate of greater ductility and superior resistance to shock, spalling and wear . . . to provide . . . a markedly stronger bond between the chromium layer and the underlying metal.

For the best results I have found that the electrolyte should be made up to contain the following quantities: chromic trioxide (CrO_3), 36–60 oz per gallon; tartaric or malic acid, 0.001–0.25 oz per gallon; hydrofluoric acid, 0.5 to 2.0 oz per gallon.

The best operating conditions will be: temperature 110°–140° F, with current densities from 200–1000 amp per sq. ft. of plated area.

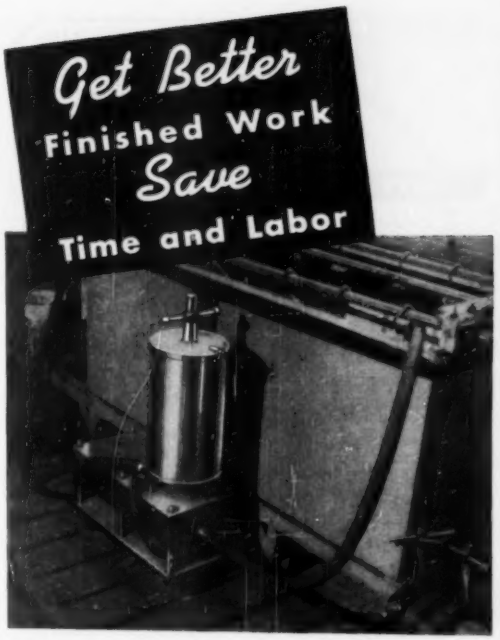
CLAIM 5. In the electrolytic plating of chromium with a plating bath consisting essentially of an aqueous solution containing from about 8 to 70 oz chromic (tri) oxide per gallon, hydrofluoric acid and an organic acid selected from a class consisting of malic and tartaric acids, the process of preventing the accumulation of trivalent chromium in the bath which consists in maintaining a sufficient quantity of hydrofluoric acid and organic acid in the bath to prevent the concentration of trivalent chromium in the bath from rising substantially above 1 per cent by weight, whereby the life of the plating bath can be extended substantially indefinitely.

5 claims.

References cited: U. S. Patents Re. 16,598; 526,114; 1,542,549; 1,928,284; 2,114,002; 2,307,551.

No. 2,517,907, August 8, 1950—Apparatus for Electroplating Metal Slide Fasteners—W. Mikulas, assignor to Conmar Products Corporation, Newark, N. J.

CLAIM 13. Apparatus for electroplating the spaced, electrically unconnected, metallic fastener elements of a pair of continuous slide-fastener stringers, the pitch of the fastener elements on both stringers being substantially the same, comprising a tank containing an electrolyte, an anode in contact with the electrolyte, an endless, supporting, flexible electrical conductor comprising a helical coiled spring, the turns of the spring having substantially the same pitch as the fastener elements on the pair of stringers to permit temporary interlocking engagement with each of the metallic-fastener elements, means for progressively and temporarily interlocking the spring turns into engagement with each of the electrically unconnected fastener elements of both stringers, means for separating the spring from the stringers as the stringers and spring leave the tank, a second tank containing an electrolyte, a cathode in contact with the electrolyte of said second tank, and means for feeding the spring through both tanks and the aforementioned means.



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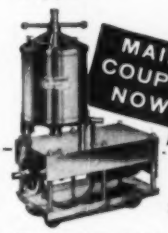

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13 claims, 10 figures.

References cited: U. S. Patents 653,715; 924,324; 2,011,328; 2,047,418; 2,052,962; 2,293,810; 2,334,054; 2,342,811; 2,344,548; 2,399,964. British Patent 449,289.

No. 2,519,858, August 22, 1950—Electrodeposition of Nickel and Nickel Alloys—Peter Spiro and Fritz Wohlgemuth, London, England.

CLAIM 2. An electrolytic bath for the electrodeposition of cobalt-nickel alloys upon metals and nonconductors in the production of pressure molds consisting essentially in aqueous solution for each gallon thereof 33 to 50 oz of nickel sulfate, 4 to 6 oz of boric acid, 1 to 2 oz of sodium fluoride, 1 to 3½ oz of cobalt sulfate, ¼ to 2 oz of sodium chloride, 4 to 20 grams of an organic hardener and stress reliever having a sodium naphthalene trisulfonate base, and 4 to 12 grams of a wetting agent consisting of a sulfonated aliphatic alcohol, and 0.2 to 1 gram of cadmium oxide to increase the ductility of the deposit after exposure to high temperatures.

6 claims.

References cited: U. S. Patents 998,085; 2,119,304; 2,147,415; 2,191,819; 2,198,267; 2,228,991; 2,238,861; 2,313,756; 2,315,802. British Patent 438,412. Ind. Eng. Chem. **33,** No. 12, 1546–1548 (December, 1941). Metal Ind. (London) **66,** 299, 300 (May 11, 1945). Metal Finishing **38,** 318–320 (June, 1940). Metals Handbook, A. S. M. (1939), pp. 1628, 1629.

No. 2,519,945, August 22, 1950—Electroplating Apparatus—K. A. W. Tuele and Albert D. Canner, assignor to General Electric Company.

It is becoming more and more the practice to have silver contact surfaces on electric-current conductors such as bus bars, switch blades and the like. In order not to waste silver, it is customary to mask the piece to be plated by some suitable coating, leaving bare only the portion on which the silver surface is desired.

An object of our invention is to provide improved apparatus for electroplating continuously with a minimum waste of electrolyte and without masking coatings . . . to provide improved electroplating apparatus utilizing the advantages of high velocity of electrolyte . . . to provide electroplating apparatus which functions substantially automatically to control the plating, draining and rinsing operations and which is practically fool proof.

We provide improved electroplating apparatus wherein a plating head is used to mask only the portion of the work to be plated.

CLAIM 1. In electroplating apparatus, a plating head to be supplied with plating current, means for conducting electrolyte to the plating head and away therefrom and for conducting a rinsing liquid to and from plating head including valve means for sequentially controlling the flow of electrolyte and rinsing liquid to the plating head, timing means for controlling the durations of flow of electrolyte to the plating head, draining of electrolyte from the plating head

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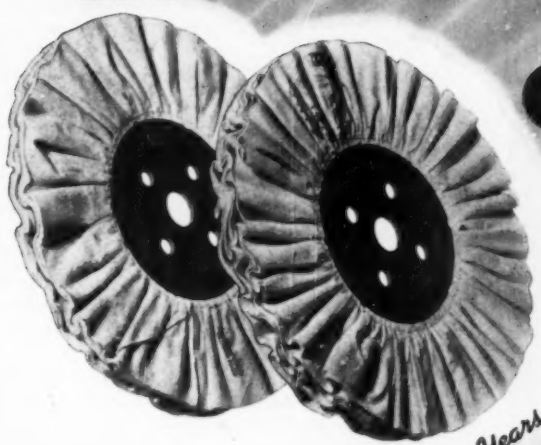

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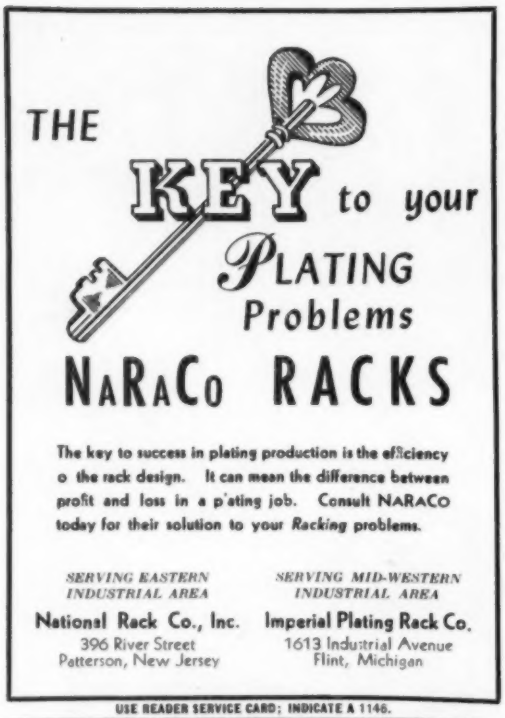
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Patent Abstracts

and flow of rinsing liquid to the plating head, cyclic switching means for controlling the flow of plating current to the plating head and sequence of operation of said timing means, and means for effecting the operation of said cyclic switching means and said valve means, comprising motive means arranged to be intermittently actuated by the conjoint action of said cylic switching means and said timing means.

20 claims, 5 figures.

References cited: U. S. Patents 565,975; 1,885,702; 2,225,350; 2,325,401; 2,352,283; 2,404,948; British Patents 26,504; 438,503.

No. 2,521,082, September 5, 1950—Electrolytic Production of Silver Chloride—John B. Mullen, assignor to Burgess Battery Co., Freeport, Ill.

This invention relates to an improved method for forming silver chloride electrolytically, and particularly to a method of electrolytically forming an adherent coating of silver chloride upon a body of silver.

. . . an electrolytic cell is made up having an electrolyte of the following composition:

Water	95 lb
Sodium chloride	6 lb
Hydrochloric acid (38% solution in water)	1 lb
Methanol	5 lb
*p*H	1.0
Current density	12 amp/sq ft
Pressure	2 volts
Temperature	40°-60° C

CLAIM 1. In anodically coating silver chloride upon a silver body in an acidic aqueous electrolyte consisting of a water-soluble chloride, the improvement which consists in including in the electrolyte a substantial amount of alcohol from the group consisting of methanol and ethanol.

7 claims.

References cited: U. S. Patents 902,755; 1,226,165; 2,428,850. British Patent 123,936. Jahn, Z. phys. Chem. **33**, 556 (1909). Moore *et al.*, Chem. Abs. **41**, 5031 (1947). J. Am. Chem. Soc. **41**, 1898–1902 (1919).

No. 2,521,106, September 5, 1950—Method and Bath for Electropolishing—Harold J. Wiesner, assignor to C. G. Conn Ltd., Elkhart, Ind.

This invention relates to a method of and a bath for electropolishing of copper and copper alloys.

EXAMPLE I

Sodium pyrophosphate (anhydrous)	16 oz/gal
Boric acid	5 oz/gal
Ammonium hydroxide (28° Bé)	2 fl oz/gal
*p*H	8.5–9.0
Temperature	140°–160° F
Current density	above 100 amp/sq ft

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EXAMPLE IV

Sodium pyrophosphate	16 oz/gal
Boric acid	5 oz/gal
Sodium oxalate or oxalic acid	4–6 oz/gal
*p*H	8.0–8.5
Temperature	180°–200° F
Current density	above 150 amp/sq ft

CLAIM 4. The method of electropolishing copper and alloys of copper comprising connecting the part to be polished as an anode in a bath consisting essentially of water as a solvent, an alkali-metal salt present in an amount ranging from 8 ounces per gallon of solution to a saturated solution of the salt, and from 2 to 12 ounces per gallon of solution of water-soluble salt selected from the group consisting of boric acid, water-soluble salts of boric acid and water-soluble salts of carbonic acid, and operating the bath at a *p*H of 7.5–9.5, at a temperature between 100° F and 212° F, and at a current density in excess of 100 amperes per square foot.

CLAIM 14. . . . consisting essentially of an alkali metal pyrophosphate present in an amount ranging from 8 ounces to an amount to maintain saturated solution, 2–12 ounces of a water-soluble compound selected from the group consisting of boric acid and water-soluble salts of carbonic acid, a neutralizing agent in an amount to adjust the *p*H of the solution to between 7.5 and 9.5, from 12 to 20 ounces of a salt of orthophosphoric acid in which the metallic component is selected from the group consisting of ammonium, sodium or potassium and from 4 to 6 ounces per gallon of a water-soluble material selected from the group consisting of oxalic acid and water-soluble salts of oxalic acid.

16 claims, 5 examples.

References cited: U. S. Patents 2,093,927; 2,326,950; 2,330,170; 2,428,141. British Patent 513,530.

No. 2,523,160, September 19, 1950—Electrodeposition of Nickel—Clifford Struyk and Stephen C. Dollman, assignors to Allied Chemical & Dye Corporation.

Yet another object is the provision of improved nickel electroplating baths—such as those of nickel sulfate, nickel chloride and particularly nickel fluoborate—containing certain agents which have been found to prevent pitting of nickel electrodeposits.

The following examples illustrate practice of the present invention.

EXAMPLE IV

Nickel fluoborate, $Ni(BF_4)_2$	300 g/l
Free fluoboric acid, HBF_4	14 g/l
Free boric acid, H_3BO_3	30 g/l
Nickel chloride, $NiCl_2.6H_2O$	1.0 g/l
Sodium salt of sulfonated tributyl aconitate	1.0 g/l
Temperature	130° F
*p*H (colorimetric)	2–3.5
Cathode current density	50–250 amp/sq ft
Pressure	1–8 volts

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EXAMPLE VI

Nickel sulfate, $NiSO_4.7H_2O$	240 g/l
Nickel chloride, $NiCl_2.6H_2O$	45 g/l
Boric acid, H_3BO_3	30 g/l
Sodium salt of sulfonated tributyl aconitate	1.0 g/l
Temperature	130° F
*p*H (electrometric)	4–5.5
Current density	5–75 amp/sq ft
Pressure	1–4 volts

EXAMPLE VIII

Nickel chloride, $NiCl_2.6H_2O$	300 g/l
Boric acid, H_3BO_3	30 g/l
Sodium salt of sulfonated tributyl aconitate	1.0 g/l
Temperature	140° F
*p*H (colorimetric)	1.5
Current density	50 amp/sq ft
Pressure	2 volts

CLAIM 1. In the process of electrodepositing nickel the improvement which comprises electrolyzing an aqueous acid solution containing a nickel salt of the group consisting of nickel sulfate, nickel chloride and nickel fluoborate and from 0.01 gram per liter up to saturation of a salt of a sulfonated ester of aconitic acid and an aliphatic alcohol, said salt of the ester containing from 8 to 25 carbon atoms.

13 claims, 8 examples.

References cited: U. S. Patents 2,389,135; 2,389,180; 2,466,677. Trans. Kansas Acad. Sci. **48**, 173, 174 (1945).

No. 2,523,161, September 19, 1950—Electrodeposition of Metals—Clifford Struyk and Stephen C. Dollman, assignors to Allied Chemical & Dye Corporation.

An object of the invention is to provide improved metal electroplating baths and methods for electrodeposition, utilization of which result in production of pit-free, uniform deposits. The more specific aspects of the invention include improved electroplating baths —such as fluoborate, chloride and sulfate baths of metals such as copper, lead, zinc, nickel, tin and iron— containing certain anti-pitting agents which have been found to effect pit-free electrodeposits.

CLAIM 2. The process of electrodepositing a metal which comprises electrolyzing an aqueous acid solution containing a fluoborate salt of the metal of the group consisting of copper, lead, zinc, stannous tin and ferrous iron and from 0.1 gram per liter to saturation of a salt of a sulfonated ester of aconitic acid and an aliphatic alcohol, said salt of the ester containing from 8 to 25 carbon atoms.

11 claims, 14 examples.

References cited: U. S. Patents 2,389,180; 2,466,677. Trans. Kansas Acad. Sci. **48**, 173, 174 (1945).

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Nos. 2,523,190–1, September 19, 1950—Electrodeposition of Nickel from an Acid Bath—Henry Brown, assignor to The Udylite Corporation.

CLAIM 1 OF 2,523,190. A bath for electrodepositing fine-grained lustrous nickel consisting essentially of an aqueous acid solution of material selected from the group consisting of nickel chloride, nickel sulfate, a mixture of nickel sulfate and nickel chloride, a mixture of nickel fluoborate and nickel chloride, a mixture of nickel fluoborate and nickel sulfate, a mixture of nickel sulfate, nickel chloride and nickel fluoborate, said solution also having dissolved therein an unsaturated organic compound selected from the group consisting of vinyl sulfonic acid ($CH_2 = CHSO_3H$), chlorvinyl sulfonic acid and bromvinyl sulfonic acid, said unsaturated organic compound having a concentration in the bath falling within the range of from about 1 gram per liter to saturation.

CLAIM 1 OF 2,523,191. . . . from the group consisting of allyl sulfonic acid ($CH_2 = CHCH_2SO_3H$) . . .

2 claims, 2 tables in each.

References cited: U. S. Patents 1,818,229; 2,029,387; 2,112,818; 2,125,229; 2,171,842; 2,198,267.

No. 2,523,253, September 19, 1950—Electrodeposition Anode—Leslie N. Smith, assignor to The Harshaw Chemical Company.

CLAIM 4. A laminated, soluble electrodeposition anode, suitable for use in an electroplating bath, comprising a plurality of layers, two of said layers including each an elongated strip of electrolytic metal sheet, and another layer interposed between said layers and including nonmetallic, nonconductive material and metallic, conductive material, said nonmetallic material being adherent to adjacent strips of electrolytic metal sheet and mechanically connecting the same together and said metallic material being nonadherent to and interposed between and electrically connecting said strips of electrolytic metal sheet, and metallic supporting means electrically connected to at least one of said strips of electrolytic metal sheet for supporting the entire anode, said nonconductive material being in the form of an elongated strip extending longitudinally of said strips of electrolytic metal sheet, being inert to and insoluble in said bath and being of a width of said strips of electrolytic metal sheet whereby to avoid interference with solution of said strips of electrolytic sheet by said nonconductive strip until a major portion of the former has been dissolved.

4 claims, 14 figures.

References cited: U. S. Patents 639,811; 981,004; 1,267,120; 1,477,109; 1,801,666; 2,256,820; 2,390,863. British Patents 14,823; 520,211. Canadian Patent 392,783. German Patent 58,956. French Patent 746,978. Swiss Patent 2,084.

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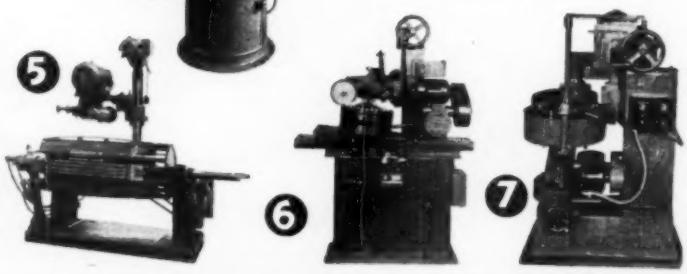

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Those who can spare the time, less than three days each way, can go by coach train for about $145.00 from New York City and back.

Some may prefer to combine railroad and air travel to save both time and money and make the round trip in less than four days at a cost of about $180.00.

Naturally, both travel time and cost is less if one travels from the Midwest.

The following gives detailed information about time and rates for travel from several cities, including special rates for family air travel, and higher rates for those who can afford deluxe accomodations. *All fares include tax.*

Regular Railroad Travel

From Chicago

First Class, lower berth	
One way	$110.24
Round trip	173.37
First Class, roomette	
One way	118.60
Round trip	190.09
Coach, chair car	
One way	56.11
Round trip	93.45
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Round trip	161.39

From Detroit

First Class, lower berth	
One way	$125.02
Round trip	203.13
First Class, roomette	
One way	133.38
Round trip	218.85
Coach, chair car One way	67.16
Round trip	112.59
First Class, special car for A. E. S. Members, if subscribed	
Round trip	194.41

From New York

First Class, lower berth	
One way	$154.60
Round trip	269.90
First Class, roomette	
One way	166.16
Round trip	293.02
Coach, chair car One way	83.40
Round trip	143.82
First Class, special car for A. E. S. Members, if subscribed	
Round trip	253.42

From Boston

First Class, lower berth	
One way	$165.65
Round trip	285.09
First Class, roomette	
One way	177.50
Round trip	308.79
Coach, chair car—One way	91.17
Round trip	157.39
First Class, special car for A. E. S. Members, if subscribed	
Round trip	268.17

Regular Air Travel

From Chicago

Via Trans World Airlines regularly scheduled 52-passenger 4-engine Lockheed Constellations. Or via American Airlines regularly scheduled 52-passenger 4-engine Douglas DC-6's. Flying time, 7 hours.

One way, 1 person	$130.81
Round trip, 1 person	248.63
2 persons*	392.50
3 persons*	523.36

*From Detroit**

One way	$148.35
Round trip	281.87

*From Boston**

One way	$191.53
Round trip	363.98

From New York

Via Trans World Airlines 52-passenger 4-engine Lockheed Constellation *or* American Airlines 52-passenger 4-engine Douglas DC-6's. Regularly scheduled. Flying time 12 hours, stopping only at Chicago.

One way, 1 person	$181.53
Round trip, 1 person	345.00
2 persons*	544.64
3 persons*	726.23

Low Cost Rail Travel

From Chicago

Via Santa Fe Railroad's "El Capitan" De Luxe Reserved Seat Streamlined All Coach Train. Leaves daily at 5:30 P.M., arrives the second morning at 7:30 A. M. Time in transit, 39 hours. Or via Union Pacific Railroad's "Streamliner" De Luxe Reserved Seat Streamlined All Coach Train. Leaves daily at 7:15 P. M., arrives the second morning at 9:00 A. M. Time in transit 39¾ hours.

One way	$ 61.94
Round trip	104.94

Via Union Pacific Railroad's "L. A. Limited" Daily Reserved Seat Coach Train. Leaves at 12:01 Noon, arrives second morning at 10:45 A. M. Time in transit 48 hours.

Round trip	$ 93.43

From New York

Via New York Central Railroad's "Pacemaker" De Luxe Reserved Seat Streamlined All Coach Train. Leaves daily at 3:30 P. M., arrives in Chicago at 7:30 A. M., and connects with aforementioned Santa Fe or Union Pacific coach trains. From New York to Los Angeles, 3 nights en route.

Round trip	$151.51

From Detroit

Via New York Central Railroad's "Mercury" Daily Reserved Seat Streamlined Coach Train. Leaves at 8:30 A. M., arrives in Chicago at 12:45 Noon and connects with aforementioned Santa Fe or Union Pacific coach trains. From Detroit to Los Angeles, 2 nights en route.

Round trip	$122.07

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From Chicago

Via Trans World Airlines "Sky Coach" regularly scheduled 80-passenger 4-engine Lockheed Constellations. Or via American Airlines "Sky Coach" regularly scheduled 80-passenger 4-engine Douglas DC-6's. Flying time, 7 hours.

One way	$ 97.75
Round trip	195.50

From Detroit

One way	$115.29
Round trip	228.85

From Boston

One way	$139.32
Round trip	277.38

From New York

Via Trans World Airline 80-passenger 4-engine Lockheed Constellation or American Airlines 80-passenger 4-engine Douglas DC-6's regularly scheduled "Sky Coaches." Flying time 12 hours, stopping only at Chicago.

One way	$126.50
Round trip	253.00

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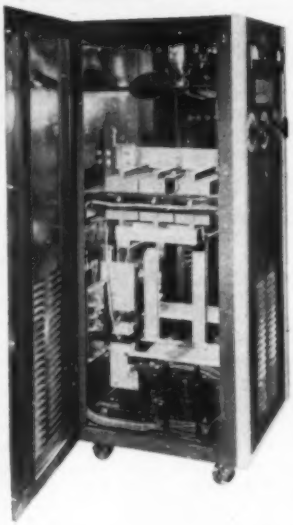

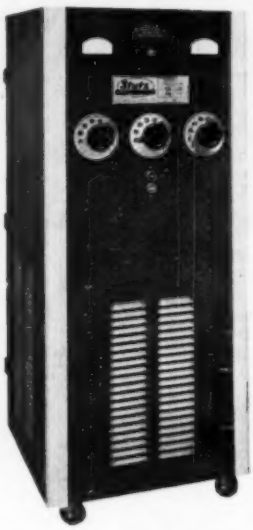

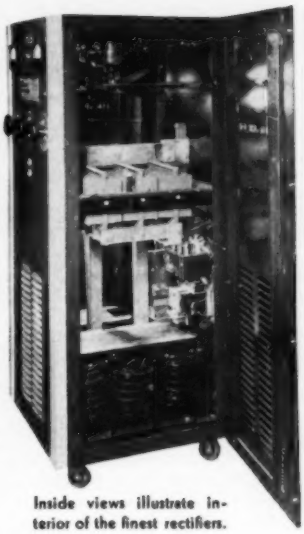

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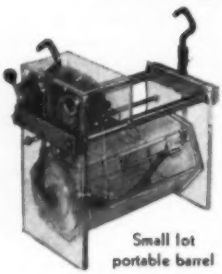

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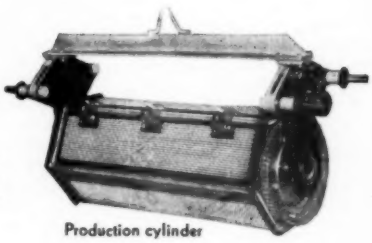

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Branch News

DETROIT BRANCH

ANNUAL EDUCATIONAL PROGRAM
AND DECEMBER PARTY
Saturday, December 2
Statler Hotel

Educational Program at 2:00 P. M.

Chairman, W. J. Neill, A. E. S. President

Speakers: Mr. George Jernstedt, Westinghouse Electric Company, "Applications of Wes-X Copper and P. R. Plating".

Mr. Harland V. Ogle and Dr. E. T. Ewing, Michigan State College, "The Distribution of Metallic Impurities in Nickel Deposits".

General interest address by a prominent executive in the automobile industry.

Banquet at 7:00 P. M.
Main Ballroom, Statler Hotel
Entertainment, Dancing

Tickets for Banquet and Entertainment may be obtained from Carl E. Heussner, 552 Brookside Drive, Birmingham, Mich., at $7.50 per person. The Educational Session is open to all interested parties.

PHILADELPHIA BRANCH

ANNUAL EDUCATIONAL SESSION
AND BANQUET
Saturday, November 18
in Broadwood Hotel
Broad and Wood Streets

Educational Session at 1:30 P. M.

Speakers: Dr. William Blum, Chief, Electrodeposition Section, National Bureau of Standards, Washington, D. C., "Effects of War on the Electroplating Industry".

Mr. R. O. Hull, R. O. Hull & Company, Rocky River, Ohio, "New Ideas in Plating and Control".

Mr. A. W. Lagozzo, Nutmeg Chrome Corporation, Hartford, Conn., "Hard Chrome Problems".

Banquet at 7:00 P. M.
Entertainment, Dancing

Tickets at $5.00 per person.

ALLENTOWN-READING BRANCH

The first meeting of the 1950–51 season was held in Spurgeons Hotel, Allentown, Pa., on September 20. Following an excellent dinner, a brief business session was held, during which NORMAN MILLER gave a report on the Society's Boston Convention.

The speaker for the evening was MR. EDWARD OTTEN of Philco Corporation, whose subject was "Corrosion Preventive Coatings." He discussed for the most part phosphate coatings on steel, giving the history of the process and the improvements added as it came into more widespread use. He also dwelt in some detail on the reactions when steel is treated, as well as on the important operation steps which should receive most attention for best results.

JAMES F. RIEGEL,
Secretary-Treasurer

CHICAGO BRANCH

While the Branch did not have any educational meetings during the months of July and August, its Executive Board met at least once a month, as did the members of the Research Committee and the Membership Committee.

In the regular order of business, new appointments included R. F. LEDFORD as Chairman of the Research Committee to replace CLYDE KELLY, who had been appointed by the National Society to other duties. Additions to the Branch Research Committee were LEONARD PRAVEL of the Manderscheid Company and LARRY GEORGE of The Udylite Corporation.

CLYDE KELLY's status of Temporary Chairman of the 1952 Convention was changed to that of Permanent Chairman.

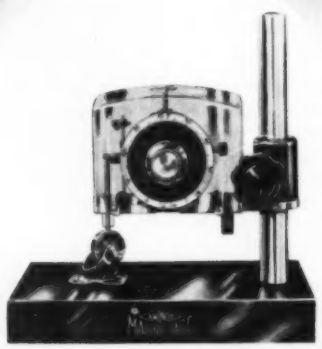
R. F. LEDFORD, *Correspondent*

CHICAGO BRANCH

The first monthly meeting after the summer vacation was held on September 8, with 53 members and guests present.

The speaker was DR. WILLIAM LANGDON of Graham, Crowley & Associates,

MEASURE THICKNESS OF COATINGS ON METALS THE EASY, ACCURATE WAY



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Inc., the subject of his talk, "Plating Room Waste Disposal Problems." Dr. Langdon ably pinch-hit for Dr. Clyde Crowley, who was to have been the speaker but was unable to be present due to a severe case of laryngitis. Dr. Langdon covered the subject in a most thorough manner, outlining advantages and disadvantages of various systems in use today. Following the talk he answered numerous questions on this most timely subject.

Those in attendance also appreciated a most enlightening discussion by Mr. W. O. Zinn of the National Plating Company on the subject of material shortages. Emphasis was placed on the necessity for conserving critical materials by improving methods, increasing efficiency, reviewing present conditions and making changes where necessary, and in general eliminating waste wherever possible.

R. F. Ledford, *Correspondent*

DAYTON BRANCH

The first meeting of the season was held at the Engineers' Club on Septemier 15.

The speaker was Dr. J. E. Stareck, United Chromium, Inc., Detroit, Mich., who gave a lecture on "Self Regulating High Speed Chromium Plating," a comparatively new method developed by him. Dr. Stareck gave in detail the advantages of the S. R. H. S. bath, among them: higher efficiency, higher speed of plating, less need for control, less trouble with passive nickel, and wider current-density range. All of these together furnish a more economical method for decorative-, hard-, and porous-chromium plating. The lecture was supplemented with numerous slides and samples. The usual question and answer period followed the fine lecture.

A film showing action in a wide field of sports followed and was enjoyed by all 29 members and friends present. One application for membership was received and accepted.

We are looking forward to a good year, and wish to take this opportunity to ask our members to bring along friends who may be interested to our meetings.

R. M. Clinehens, *Secretary*

DETROIT BRANCH

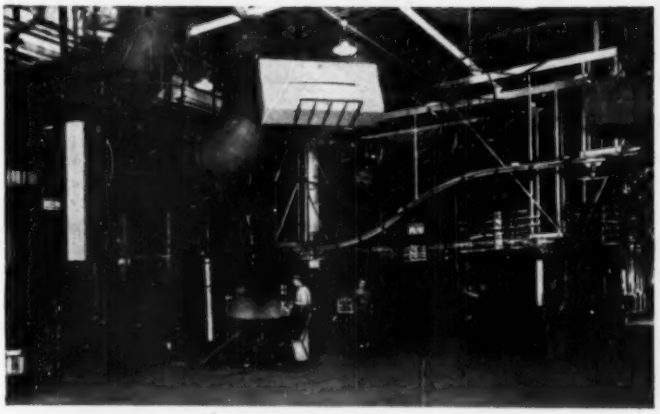
The Branch, largest unit of the Society, resumed its monthly meetings on September 8 after the four-month summer interval.

Following a business session of the Executive Board, the program opened at 8:30 P. M. in the Wayne Room of Hotel Statler. More than 200 members were present to hear Mr. E. G. Schroeder of the Electric Products Company, Cleveland, Ohio, present a most interesting talk on "Plating Power—Its Application and Usage."

E. A. Hahn, new president of the Branch, announced a schedule of inter-

Briggs plates chrome directly on stainless

Wyandotte's MK Emulsion and B.N. Cleaner help Briggs chrome plate 3000 stainless steel automobile grilles a day



Sure, stainless steel is an ideal base metal for chrome plate. Sure, you need no undercoating of nickel or copper-nickel.

Just the same, it gets tough when you're plating a 5-foot by 2-foot welded stainless assembly. And, too, type 301 austenitic stainless has a low electrical conductivity — and that increases the amount of copper needed in the racks . . . and makes them more complex. Too, the assemblies had more than a fair amount of recessed areas.

That's why MK's long life, high detergency and emulsion stability came in handy . . . to remove buffing compound from the highly polished steel . . . and to do it 24 hours a day. Wyandotte B.N. Cleaner helped, too . . . in anodic cleaning it wet out rapidly, rinsed quickly, proved to have long life in solution. Can you use any of those qualities in a metal cleaner? Ask your Wyandotte Representative to tell you about "The Wyandotte Line."

THE WYANDOTTE LINE—products for burnishing and burring, vat, electro, steam gun, washing machine, and emulsion cleaning, paint stripping, acid pickling, related surface treatments and spray booth compounds. An all-purpose floor absorbent: Zorball — **In fact, specialized products for every cleaning need.**

Wyandotte Chemicals Corporation
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Service Representatives in 88 Cities

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esting speakers for the next two meetings, on October 6 and November 3. Every effort is being made to cover subjects of timely interest to the members, he pointed out, and to obtain speakers best qualified to handle them.

The meeting wound up with light refreshments.

E. A. Steegar,
Publicity Chairman

HARTFORD BRANCH

The first meeting of the season, held in the Bond Hotel on September 18, was attended by the unusually small crowd of 35 members and guests. Preceding the meeting, George Hogaboom gave a brief talk on changes taking place in government plating specifications. He will give a similar talk before each monthly meeting to keep the Branch abreast of these specification changes.

Mr. Hogaboom was also scheduled to present abstracts he had prepared of the Boston convention papers, but because of his cold they were given by Ralph McCahan, Educational Advisor. Mr. Simons acted as the Technical Chairman during the discussion which followed.

Arthur Logozzo then presented "The Story of the A. E. S.", an interesting talk on the formation of the Society and its steady growth, illustrated by slides.

Refreshments were served through the courtesy of the Lea Manufacturing Company.

Stanley Platoz, *Secretary*

JACKSON-LANSING BRANCH

The Branch held its first meeting of the 1950–51 season in the Meadow Lark Inn, Jackson, Mich., on September 12.

Bill Webb, Sales Manager of the Detrex Corporation and one of the founders of the Branch, told a very interesting story of the problems encountered and solved in getting the Branch started some 8 years ago.

The meeting was then thrown open to a general discussion of plating problems. It became extremely lively, with both platers and suppliers explaining how they manage to continue operations in spite of present-day shortages.

Entertainment was furnished by Bob Stewart, a member of the Michigan State College coaching staff, who gave the members an idea of what to expect during the coming football season. He also presented a color movie of the 1949 Michigan-Michigan State football game, with a running commentary of the action taking place on the screen.

It was well past the hour of twelve when this meeting was finally adjourned.

Fred W. Stuckenberg
Publicity Chairman

LANCASTER BRANCH

The first fall meeting of the Branch was held on September 15 at the Hanover Country Club, when 43 members and guests were served a lobster-tail dinner through the courtesy of the Hanover Wire Cloth Division of the Continental Copper & Steel Industries, Inc.

Harry Hovis, Chairman of the By-Laws Committee, reported the by-laws ready for printing.

Librarian Ray Vines introduced the speaker, Mr. Tom Rodgers of Hanson-Van Winkle-Munning Company, who spoke about "Plating Room Hints." He stressed causes of inefficiency and methods of correcting troubles in tin, chromium, and nickel baths. He also gave useful hints for setting up a plating room.

The Branch is planning to give assistance in arranging a course in electroplating at McCaskey High School, Lancaster, Pa.

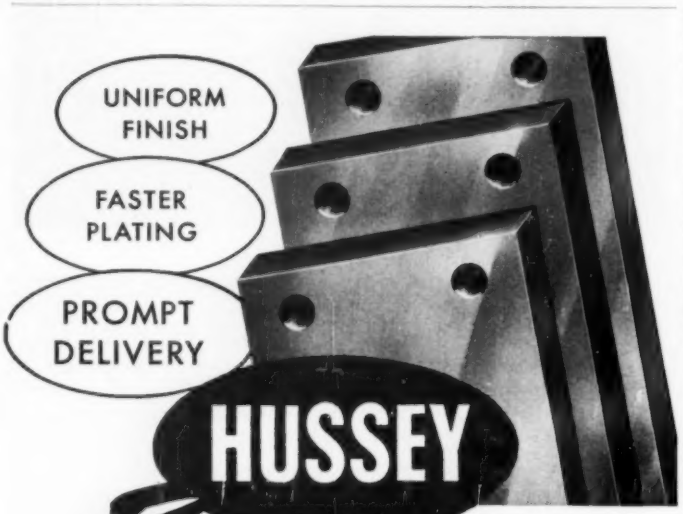
Activities of the Branch are being publicized in daily newspapers in York, Lancaster and Harrisburg and through announcements over Radio Station WLAN in Lancaster.

Harry A. Saylor
Secretary-Treasurer

MELBOURNE BRANCH

Two hundred and ten people were present in the Melbourne Public Library lecture theatre on Friday, September 21 to hear a talk on "Modern American Trends in Electrodeposition," the first lecture in a series of three given by Mr. John J. Dale.

After outlining the course of his trip in America, Mr. Dale named the following as the most apparent trends: (1) The increasing use of fully automatic plants. The introduction of such plants to Australia would be unwarranted except in a very few cases, but for the quantity of work being produced in the U. S. A., it has many advantages. (2) The metals



Here are the basic tools for real craftsmanship in electroplating. Available in a full range of shapes and sizes, Hussey Pure Copper Anodes assure uniform finish and fast, dependable plating. For fastest service call the Hussey warehouse near you.

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CLEVELAND	5318 St. Clair Avenue	ST. LOUIS	1620 Delmar Boulevard
NEW YORK	140 Sixth Avenue	PHILADELPHIA	1632 Fairmount Avenue
CINCINNATI			424 Commercial Square

being plated. Bright nickel-chromium is still popular, but greater thicknesses, up to 0.003 inch, are being plated. One section of platers insists that better corrosion resistance is afforded by copper undercoats, whereas another section believes that copper undercoats add little to the protection afforded by the nickel. Each side supports its belief with results of exposure tests, but conditions of these tests vary, and herein may lie the answer. Zinc plating was seen more often than cadmium, being cheaper and in many cases better. Alloy plating was being used to an increasing extent; bronze, lead-tin, and lead-tin-copper were among those being plated. (3) Direction of research towards elimination of lathe buffing and polishing. This objective was being gradually attained through (a) improvement in surface finish of the material as delivered to the shop; (b) "flat polishing" of blanks prior to forming; (c) electro- and chemical polishing; (d) avoiding roughness in deposits by the use of agitation, diaphrams, addition agents, and filtration; (e) bright plating; (f) baths having a smoothing, or levelling, action which "fill up" scratches in the base metal; (g) periodic-reverse-current plating, which was giving good results.

The technical excellence of plating in U. S. A. was chiefly due to the many good scientists who are specializing in electroplating, to the excellent control and equipment (particularly in the larger plants), and to the fact that technical help is always readily available.

Mr. Dale expressed his thanks to all, both in Australia and in America, who had been so cooperative and helpful in planning and organizing his tour.

Sir Herbert Gepp, in moving the vote of thanks, said that it was good to see that a young man had been sent overseas to concentrate his attention on one subject, instead of being expected to note new developments in a number of fields. If we are to keep our industries abreast of modern developments, it is essential that our scientific societies arrange meetings such as this, he stated.

Rowland H. Keller
Assistant Secretary

MILWAUKEE BRANCH

The traditional Racine Meeting of the Branch was the kick-off of a big membership drive. The good Danish food, the entertainment, the good fellowship and the free beer that Ken Olsen and his all-Racine committee provided was enjoyed by over 100 members and guests. The 100 per cent cooperation by Racine's manufacturers and suppliers and by Ken's committee—Walter Vogel, Herman Haase, Rod Olsen, Ray Goodsell, Louis Bush, Bob Toeppi, and Wallace Jarvis—made it a night to remember.

President Leslie Diveley analyzed the membership in the Milwaukee Branch and spoke of the benefits that the Society offers to young platers. He has appointed First Vice-President Everett Robinson chairman of the Membership Committee. Members of this committee are L. J. Moyes, C. O'Donahue, Cy Bevins, Walter Wiese, S. Stroinske, H. Kruger and W. Lawrie.

A discussion of the deteriorating situation in plating supplies was led off by Mr. Larry George of The Udylite Corporation. Messrs. Oscar Meline of Harshaw, Louis Schustig of DuPont, Gene Bosl of H-VW-M, and R. F. McGuire of Donald Sales contributed to the general round-table discussion.

Program Director Vincent Mattacotti has planned a year-long "Brush-up Course in Electroplating," that will bring eminent speakers to our meetings to review the fundamentals and present the newest developments in their respective fields.

On November 3, the Branch will be host at the 17th Annual Walter Pinner Dinner. Mr. Pinner will present "Nickel Plating," a subject on which he is a recognized authority.

E. E. Piellusch
Secretary-Treasurer

MONTREAL BRANCH

The Branch resumed its regular monthly meetings September 5 at the Mount Royal Hotel, with 45 members and guests present and First Vice-President J. G. Carrique presiding.

The speaker was Mr. A. M. Brown of Divine Bros. Co., Utica, N. Y. Highlights of his address on "Polishing As a Machining Operation" were the treatment, preparation and heading of wheels, with emphasis on the selection of grit and glue. Good housekeeping in the polishing room, the centering and balancing of wheels, and the choice of speeds were

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INCREASED PRODUCTION—Scientific "know-how" of the blending of abrasive grains and binders and proper selection of the compound suited for the job gives you the most uniform finish and increases speed of production.
ECONOMY IN USE—The improved and more durable binder gives ideal adhesion to the wheel; drying time and less "off the wheel" wastage.
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discussed thoroughly, as were methods of production in the rolling mills and the stamping of steel. The speaker contended that polishing should be considered as a machining operation, and that the polishing and buffing department should not be used as repair shops in the production line.

G. R. DAVIDSON of Canadian Hanson & Van Winkle Company thanked the speaker for taking random facts and putting them in an orderly, constructive sequence. Mr. Brown's discussion had shown all present where costs could be cut in the polishing room.

A discussion of the coming Annual Branch Banquet followed.

WM. GLOVER, *Secretary*

PITTSBURGH BRANCH

The meeting on September 14, inaugurating the Branch's 32nd year, was a sparkling affair. It was gratifying to see many old friends warmly greeting one another.

PRESIDENT E. J. SMITH, overwhelmed at finding all officers present, regained his composure and conducted an orderly, succinct business session.

Following TREASURER SCHINDLER's announcement of a reasonably fat balance, A. E. S. PAST PRESIDENT S. S. JOHNSTON commented, in his own broad manner, on the Boston Convention. Among the items to receive his high praise was the clam bake, well attested to by President Smith who is reported to have manifested roomy alimentary facilities. (The Branch is entering a claim for the record, Mr. Smith having consumed five lobsters.)

Committee reports were received from the following committee chairmen: R. J. GOLDBACH, Executive Committee; E. B. WASHBURN, Librarian's Committee; S. S. JOHNSTON, Research Committee; and R. A. WOOFTER, Membership Committee.

W. J. HENNESSY, Senior Member of the Board of Managers, explained a plan fostered by several technical societies to consolidate the bargaining power of the various groups in Pittsburgh to improve general meeting and eating facilities.

The committees for the new year were announced. Two in particular should be mentioned. ROBERT GEUDER was named Chairman of a Sub-Committee under the Librarian to arrange a social function for the December meeting. Last year's "Milwaukee Night" is pleasantly remembered by all who attended. W. J. HENNESSY, Chairman, S. S. JOHNSTON, and R. J. GOLDBACH were appointed a Keller Campaign Committee. MR. FRANK KELLER has been prevailed upon to stand for National Office next year in Los Angeles. This Committee is to exert every effort to present the fine character, ability and achievement of Mr. Keller to the Society as a whole.

The talk by ROBERT H. DUDLEY, Industrial Engineer of United Chromium, Inc., on the subject of "Self-Regulating High-Speed Chromium Plating" was well presented. The information was unique and interesting. Mr. Dudley received a sustained ovation for both his speech and later remarks to questioners. The Librarian is to be congratulated for his fine program, which is a clear indication of things to come.

J. M. DAVIDSON, *Secretary*

ROCHESTER BRANCH

The September 18 meeting was called to order by PRESIDENT JOHN DUFORD promptly at 8:15 P. M. in the Rochester Institute of Technology. Although competing with a critical game at the Red Wing Stadium, which Rochester won, some twenty or more members were on hand to consider the Fall membership housecleaning and to hear the first of a series of educational talks devoted to aspects of electroplating which are often overlooked.

The topic for the evening was "Safety." The speaker, MR. CHARLES KUPFERSCHMIDT, Safety Engineer, Rochester Products Division of General Motors Corporation, succeeded in stimulating a lively discussion of plating-room hygiene and safety. After his talk a sound movie on safety was shown.

Those who did not attend, should be on hand next month. R. B. is "springing."

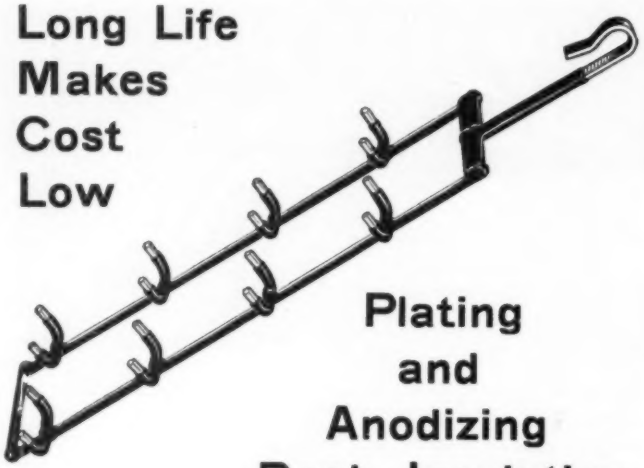
WALTER F. SWANTON, *Secretary*

SAGINAW VALLEY BRANCH

The first dinner meeting of the Branch, following vacations, was nontechnical. Attended by 44 members and guests, it was held at the Zehnder Hotel, Frankenmuth on September 5.

SERGEANT LESTER COYKENDALL of the Michigan State Police, one of the leading pistol-shooting experts of the Nation, gave an excellent exhibition of handling and use of firearms.

Long Life Makes Cost Low



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Two hunting films concluded a most entertaining evening.

W. W. KAUFMANN, *Recording Secretary*

ST. LOUIS BRANCH

There have been no meetings during the Summer, but all officers of the Branch met during the last week in August to plan the coming year's program. The first meeting following the vacation period will be held on the second Wednesday in October.

EDWARD HUNLETH, *Secretary*

SYRACUSE BRANCH

The Branch started its 1950–51 season on September 15 with an affair looking very much like the National Convention. It was held in the small town of Herkimer, N. Y., about 65 miles east of Syracuse. Herkimer is where GEORGE SIMMONS lives, and where he plates about all the nut crackers and picks in the world at the H. M. Quackenbush Co. plant.

This company very kindly opened its doors to the members (and some ringers). Mr. Simmons has been preaching specification nickel plating in barrels for years, and we saw him doing it. The company also runs a job plating plant, plating about everything that comes along.

Dinner, a splendid meal of ham or swordfish, was served at 6 o'clock at the Prospect Hotel, about 52 persons attending.

An hour's excellent entertainment through the kindness of the Quackenbush Company started off with the Ambassador from "Community," the one and only DAN GREY, who was introduced by the gentleman from Missouri, MR. B. G. DAW of Lasalco. Dan had quite a few of the boys fidgeting, afraid he would include them in the Slobovian population. He was followed by a very nice girls trio who sang about how all men are quite beneath contempt. A couple of black-faced boys then panned quite a few of the members.

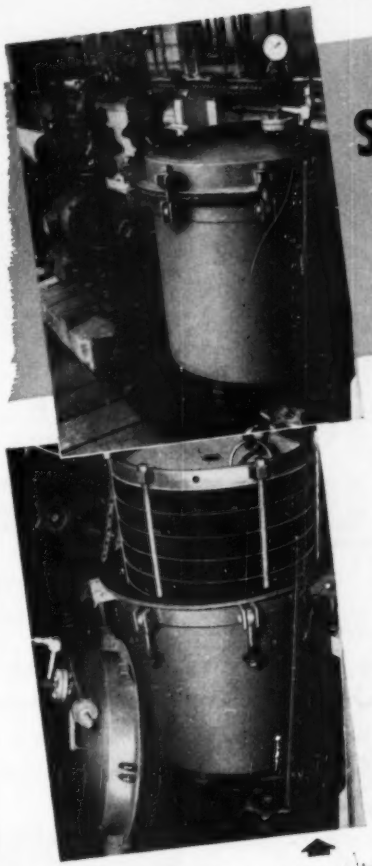
MR. GUFFIE of United Chromium, Inc., had kindly come to give us some inside information about the new high-speed chromium bath. He covered the subject very well and was frank enough to tell us some of the troubles that could happen with this new process.

We were very glad to welcome CLIFF WHEELER of Elyria, Ohio; A. E. S. old friend BILL FOTHERINGHAM, and TED INFIELD of G. E., Schenectady. We missed two of our active members, HANK HOLBERT of Easy Washer and NEIL MAFFEI of General Motors, both on the sick list. We wish them a speedy recovery. Our Mohawk Valley member from Remington Rand, PETE KIDDER, had to leave after the meeting on invitation of General Groves of Atom fame.

All attending this affair thought the Branch had made a good start for the coming season. We are indebted to George Simmons and his associates for a fine job.

LINDLEY S. WOOD, *Secretary*

No repairs or maintenance in over 17,000 hours of 'round-the-clock operation



. . . yet this SPARKLER *Horizontal Plate* FILTER is still going strong

The kind of service Sparkler Horizontal Plate Filters have given the Gillette Safety Razor Company—efficient and trouble-free, even under most extreme conditions—is the kind of service that is vital to *every* filtering operation.

For example: A rubber-lined Sparkler Model 8-18 filter is used by Gillette in the continuous filtration of a 1000-gallon bright nickel plating solution. Now operating for approximately two years, this filter has been on a 24 hours a day, 7 days a week schedule — without any loss of operating time for repairs or maintenance. Also used in periodic batch carbon treatments of nickel solutions this unit, according to Gillette technicians, consistently delivers a brilliantly clear effluent, even though the plates may be packed solid.

Another Sparkler Filter employed by Gillette is a Model 8-6, stainless steel, portable unit. Used exclusively for cyanide type plating solutions, this Model 8-6 has proved particularly valuable for Gillette's gold plating operations since the patented Sparkler Scavenger Plate assures minimum loss of precious gold solution. Now operating almost six months for at least 2 hours daily, its performance has been satisfactory in every respect.

Top: Sparkler Model 8-18 filter shown installed in Gillette's plating department. Above: Same filter, with filter plate assembly being removed for cleaning

Left: Sparkler Model 8-6 stainless steel filter. This portable unit is used by Gillette to filter gold plating solutions.

Our Engineering Department (with more than 25 years' experience in every phase of filtration) is available for consultation without charge.

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. . . and get NEW ANODES from YOUR NICKEL SCRAP

You can beat the nickel famine!

Dig into that nickel mine in your scrap bins. Send us those ends, swords, stubs — any nickel anode scrap. We'll cast your own metal into new oval anodes, drill and tap for hooks and ship to you pronto. You paid for this metal; why not use it? It represents a reliable source of nickel at this time and the cost of re-conversion is low. Wagner Brothers, Inc. has installed the finest melting and casting equipment available and your metal is processed under stringent metallurgical control. We're centrally located, easily reached at low transportation cost.

To handle a large volume of metal efficiently, we recommend a standard ordering and shipping procedure. Just fill out the coupon in detail and we'll send full directions for packing and shipping, and quote on any quantity.

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Stubs, average length _____ inches
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Membership Report of the A. E. S.

Elections

ALLENTOWN - READING BRANCH: Donald L. Clupper

BALTIMORE-WASHINGTON BRANCH: Wade E. Hough, L. Coburn Kingsbury

CHICAGO BRANCH: Lewis M. Glassner

DETROIT BRANCH: J. Barton, H. E. Bridges, R. J. Brown, R. A. Boyd, H. L. Eves, P. W. Goodwin, L. A. King, A. E. Olsen, R. D. McAleer, S. Pawlak, Buck M. Rodgers, J. A. Seeman, R. A. Spaulding

HARTFORD BRANCH: Frank J. Legas

INDIANAPOLIS BRANCH: Harold Lay

LOS ANGELES BRANCH: A. H. Heath, Keith Holtzclaw, Theodore A. Kerttu, Harry C. Osborn, Tony Stabile, Raymond Steele, D. W. Vance

MILWAUKEE BRANCH: Robert P. Crooks, Juel O. Severson

NEW YORK BRANCH: Philip P. Bruno, William De Chirico, Thomas P. Hartnett, Jr., Arthur R. Karren, Coney R. Liguari, William H. Nicholson, Edward B. Saubestre, James A. Viola

PITTSBURGH BRANCH: Glenn B. Frye

ST. LOUIS BRANCH: Francis X. Kaiser, Max S. Kaiser, Homer Schwartzel, Charles R. Sorber, Arno L. Weller

SAN FRANCISCO BRANCH: Alan Baker, Albert J. Strohmaier, Ben Weinstein

SOUTHEASTERN BRANCH: Charles Borochoff, Joseph A. Wilkosz

WATERBURY BRANCH: Edward C. Bertucio, Domenic Mencio, Michael J. Orient, James F. Vuolo, Frank A. Webber

MEMBERSHIP-AT-LARGE: Edward L. Lange, Jr.

Reinstatements

MILWAUKEE BRANCH: Roman R. Lipinsky

ST. LOUIS BRANCH: Kenneth Repp

Transfers

George J. Kahan from Waterbury Branch to Cincinnati Branch; John Kosmos from Hartford Branch; Harry De Jong from Los Angeles Branch; Arthur O. Nieman to Los Angeles Branch; W. F. Castell to Los Angeles Branch; Frank Passal from Waterbury Branch;

Resignations

CHICAGO BRANCH: Irene Donnelly

DAYTON BRANCH: Clifford Speck

LOS ANGELES BRANCH: Florence English, Roswell C. Koch, W. G. Luitjens, John R. Mergell, Edward J. Mooney, Thomas R. Morrison, Bert E. Tuthill

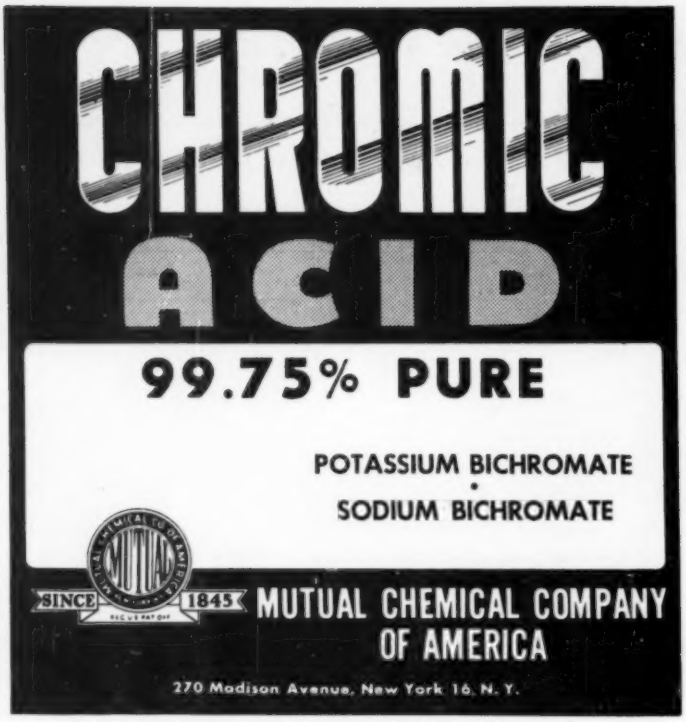
MILWAUKEE BRANCH: Henry Binder, H. C. Jaeger

Membership Competition

BRANCH	Membership April 1, 1950*	New Members	Net Change in Membership	Per Cent Net Change
FIRST GROUP				
GRAND RAPIDS	141	6	+17½	+12.4
CLEVELAND	195	18	+15½	+ 7.9
BOSTON	142	12	+11	+ 7.7
DETROIT†	483	36	+33½	+ 6.9
NEW YORK	280	13	+14	+ 5.0
CHICAGO	372	18	+14½	+ 3.9
TORONTO	124	6	+ 3	+ 2.4
PITTSBURGH	142	2	+ 2½	+ 1.8
WATERBURY	125	5	+ 1	+ 0.8
HARTFORD	132	5	+ 1	+ 0.8
BRIDGEPORT	155	4	− 1	− 0.6
PHILADELPHIA	192	4	− 2½	− 1.3
MILWAUKEE	124	4	− 4	− 3.2
LOS ANGELES	201	14	− 7½	− 3.7
NEWARK	238	2	−12½	− 5.3
SECOND GROUP				
MELBOURNE†	111	9	+ 5	+ 5.0
CINCINNATI	87	3	+ 4	+ 4.6
MONTREAL	68	6	+ 2	+ 2.9
BALTIMORE-WASH.	85	5	+ 2½	+ 2.9
ST. LOUIS	97	7	.....	.....
NEW HAVEN	106	..	− ½	− 0.5
INDIANAPOLIS	97	5	− ½	− 0.5
TWIN CITY	71	..	− 5	− 7.0
ADELAIDE	72	4	− 6	− 8.3
PROV.-ATTLEBORO	112	3	−10	− 8.9
SYRACUSE	85	5	−11	−12.9
SYDNEY	109	4	−16	−14.7
ROCHESTER	104	4	−21	−20.2
THIRD GROUP				
ROCKFORD	64	9	+ 9	+14.1
ALLENTOWN-READING	37	5	+ 4	+10.8
COLUMBUS	47	3	+ 4½	+ 9.6
HAMILTON	23	1	+ 1	+ 4.3
SPRINGFIELD	51	1	+ 1	+ 2.0
WESTERN ONTARIO	23	..	.....	.....
ST. JOSEPH VALLEY	66	6	− 2	− 3.0
SOUTHEASTERN†	54	3	− 5	− 9.2
LANCASTER	62	..	− 6	− 9.7
JACKSON-LANSING	57	..	− 7½	−13.1
SAN FRANCISCO	66	10	− 9	−13.6
LOUISVILLE	25	..	− 4½	−18.0
SAGINAW VALLEY	64	..	−14	−21.8
TOLEDO	49	2	−14	−28.6
OUTSIDE COMPETITION				
AT LARGE	104	18	+17	.....
IN TRANSFER	27	..	− 2	.....
TOTAL A. E. S.	5,236	266	− 7	− 0.1

Active Membership, September 1, 1950.....5,229

Subject to correction. †Winners of membership competition in 1949-1950.



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ALLENTOWN-READING meets third Wednesday of each month in Spurgeon's Hotel, Allentown, Pa. Secretary-Treasurer, James F. Riegel, 425 S. 18th Street, Allentown, Pa. Research Finance Committee Chairman, William R. Pfeiffer Jr., 975 Green St., Allentown, Pa.

BALTIMORE-WASHINGTON meets second Tuesday of October, December, February, and April in Baltimore at the Engineers' Club, and of November, January, March, and May in Washington, D. C., at the Garden House, Dodge Hotel. Secretary, George E. Best, c/o Research Department, Mutual Chemical Company of America, 1348 Block Street, Baltimore 31, Md.

BOSTON mee.s first Thursday of each month in Hotel Statler. Secretary, Dr. George P. Swift, 53 Galen Street, Watertown, 72, Mass. Research Finance Committee Chairman, Eugene P. Carter, c/o United Carr Fastener Corporation, 81 Ames Street, Cambridge, Mass.

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CHICAGO meets second Friday of each month at 8 P. M. at Western Society of Engineers, 84 E. Randolph Street. Secretary-Treasurer, Paul Glab, 882 N. Paulina Street, Chicago, Ill. Research Finance Committee Chairman, Clyde Kelly, 740 W. Englewood, Chicago 21, Ill.

CINCINNATI meets fourth Wednesday of each month at 8 P. M. in Engineering Society Headquarters, McMillan Street and Woodburn Avenue. Secretary-Treasurer, Charles Wise, c/o The Buckeye Products Company, 7020 Vine Street, Cincinnati 16, Ohio.

CLEVELAND meets first Friday of each month in Cleveland Hotel at 8 P. M. Secretary-Treasurer, Harry Pochapsky, 24961 Euclid Avenue, Euclid 17, Ohio. Research Finance Committee Chairman, E. C. Friedl, c/o duPont Company, 1335 Guardian Building, Cleveland 14, Ohio.

COLUMBUS meets first Friday of each month at 8 P. M. in Battelle Memorial Institute Auditorium. Secretary-Treasurer, Nathan L. Koslin, 2641 Cleveland Avenue, Columbus 11, Ohio.

DAYTON meets first Friday of each month in Engineers Club. Secretary, Richard M. Clinehens, 701 W. Stewart Street, Dayton 8, Ohio. Research Finance Committee Chairman, C. W. Powell, 3112 Princeton Drive, Dayton 6, Ohio.

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HAMILTON BRANCH. Secretary, W. Finlay, 7 Hill St., Hamilton, Ontario, Canada.

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LOS ANGELES meets second Wednesday of each month at 6:30 P. M. in Rodger Young Auditorium. Secretary, G. D. McDonald, Jr., 3114 Purdue Avenue, Los Angeles 34, Calif.

LOUISVILLE meets third Thursday of each month in Room 119, Speed Scientific Building, University of Louisville. Temporary Secretary, Stanley J. Beyer, 1304 Barret, Louisville 4, Ky. Research Finance Committee Chairman, Garland Logsdon, 1519 Central Avenue, Louisville, Ky.

MELBOURNE, AUSTRALIA, meets third Thursday of each month at 8 P. M. in Metallurgy Theatre, Melbourne Technical College, 124 Latrobe Street. Hon. Secretary-Treasurer John J. Dale, c/o Defence Research Laboratories, Maribyrnong, Victoria, Australia.

MILWAUKEE meets first Friday of each month in Red Arrow Club, 774 N. Broadway. Secretary-Treasurer, E. E. Piellusch, 2921 S. 90th Street, West Allis 14, Wis. Research Finance Committee Chairman, James Paulson.

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The same source points out that this has been made possible by a parallel growth in output per man hour, from 51 cents (in terms of the 1949 dollar) to $1.89, and that this growth in turn is the result of revolutionary or near-revolutionary changes in production methods; much larger capital investment per worker; important advances in the health, training and skill of the labor force; and great improvement in management methods.

There is no question but that future economic progress must come about along the same lines.

Sincerely,

Gustaf Soderberg

Future Meetings

Fourteenth Annual National Time, Motion and Management Clinic of the Industrial Management Society in Sheraton Hotel, Chicago, Ill., on November 2-3.

Philadelphia Branch, A. E. S. Annual Educational Session and Banquet in Broadwood Hotel, Broad and Wood Streets, Philadelphia, Pa., on November 18, 1:30 and 7:00 P. M.

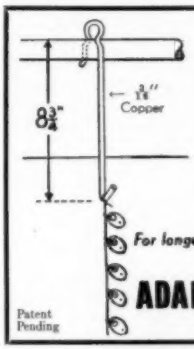
Newark Branch, A. E. S. Annual Christmas Party and Banquet in Hotel Robert Treat, Newark, N. J., on December 16. Educational Session at 2:00 P. M., Party at 7:00 P. M.

Second Plant Maintenance Show and Conference in the Auditorium, Cleveland, Ohio, on January 15-18, 1951.

American Society for Testing Materials Spring Meeting and Committee Week in Cincinnati, Ohio, on March 5-9, 1951.

Boston Branch, A. E. S. Annual Technical Session and Banquet in Hotel Statler, Boston, Mass., on April 7, 1951.

American Electroplaters' Society Annual Convention in Hotel Biltmore, Los Angeles, Calif., on June 25-28, 1951.



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UPPER DARBY, PA.

USE READER SERVICE CARD; INDICATE A 1173.

ROCHELTEX

COPPER ADDITION AGENT

ROCHELTEX Copper Addition Agent when added to any standard cyanide copper plating solution results in a smoother, more lustrous copper deposit.

ROCHELTEX *can be added to any cyanide copper solution.*
ROCHELTEX *cuts cyanide consumption up to 50%.*
ROCHELTEX *increases cathode efficiencies 20%.*
ROCHELTEX *completely eliminates carbonate build-up.*

MACDERMID INCORPORATED Technical Service Representatives located in all principal cities have been individually trained for the purpose of helping manufacturers secure maximum results through the use of ROCHELTEX Copper Addition Agent and other individually formulated and standard MACDERMID INCORPORATED compounds. This service is yours for the asking without obligation. If general information concerning ROCHELTEX or other MACDERMID INCORPORATED compounds is desired . . . .

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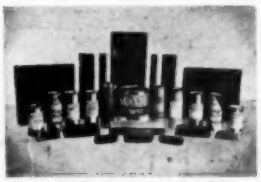
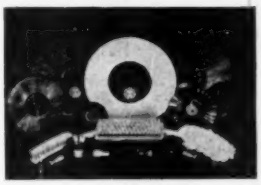
Always know what you're getting

when you buy plating and polishing equipment & supplies



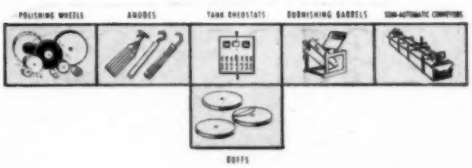
Be sure you are getting the benefit of laboratory composition research. The H-VW-M laboratory is constantly engaged in research to improve the cutting and coloring properties of all types of buffing compositions. 6-B-97, an exceptional stainless steel cutting rouge, is the latest result of this program. It yields an exceptional degree of color along with deep cut found only in the use of coarser abrasives.

Oil-water emulsion liquid tripoli compositions are also available for spray gun application on automatic buffing machines. Deepest cut is obtained with 2-L-178, while the best color is left by 2-L-177. The latter is in the double-duty cut-color classification. Both are tripolis for use on virtually all non-ferrous metals. H-VW-M welcomes research opportunities on specific buffing problems.



Be sure the brushes you buy are right for trouble-free service. H-VW-M recommends StapLBond Tampico brushes for use with emery paste or other compositions for polishing irregular steel surfaces; with pumice or special compositions for satin finishes; for cleaning all metals. H-VW-M StapLBond Steel Wire Brushes are recommended for heavy brushing on rubber, castings, gear teeth and for removing scale, rust, etc., from metal surfaces. Brass wire brushes are used for brushed or satin finish on brass or copper. Stainless wire brushes prevent rusting and nickel-silver is used on non-ferrous metals other than brass or copper. The complete line of H-VW-M quality brushes in a full range of materials is described in Bulletin BR-104.

Be sure your plating conveyors are always ready for heavy duty. H-VW-M Full-Automatic Conveyors always are. Motors have variable speed drives; rugged carriers have self-lubricating fingers for heavy current loads; electrical circuits provide for inside auxiliary anodes; periodic reverse type plating is provided for as well as motion plating for uniform deposits of required thickness. Result? A marked reduction in rejects, lowered costs, a better product. H-VW-M is the most experienced builder of automatic plating machines in the world. Why not consult our engineers or write for Bulletin No. FA-103?



Yes, be sure you know what you're getting . . . and be assured you can always get what you want from H-VW-M when you want it . . . H-VW-M products are strategically warehoused for prompt service and delivery . . . H-VW-M sales-engineers and laboratory technicians are always available for help in your production problems. It is this overall service and experience that have made H-VW-M *the central source of supply . . . for over 80 years . . . for all the needs* of the electroplating and polishing industry.

HANSON-VAN WINKLE-MUNNING COMPANY, Matawan, N. J.
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H-VW-M

Manufacturers of a complete line of electroplating and polishing equipment and supplies

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1175.